PLACES TO GROW

BETTER CHOICES. BRIGHTER FUTURE.

Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe

Prepared by

Ontario Growth Secretariat

Ministry of Public Infrastructure Renewal

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Table of Contents

Introduction 1

Places to Grow - A Growth Plan for the Greater Golden Horseshoe 1
The Built Boundary and the Growth Plan 2
Developing a Built Boundary for the GGH 3
Purpose of this Technical Paper 4
Feedback and Next Steps 5

Key Steps In Identifying Built-up Areas 6

Step 1: Create a Parcel Land-Use Database 7
Step 2: Select Settlement Areas for which a Built Boundary will be Developed 10
Step 3: Generate Grid-cell Mapping for the Settlement Areas Identified in Step 2 12

Next Steps In Defining A Built Boundary 19

Step 4: Apply Refinement Rules 19

Seeking Feedback 26

Appendices 27

Appendix 1: Definitions 28
Appendix 2: Bibliography 30
Appendix 3: Overview and description of MPAC and OPA datasets 33
Appendix 4: Assignment of summary land-use codes to MPAC property codes 36
Appendix 5: Other data sources evaluated for the proposed built boundary methodology 44
Appendix 6: Built grid-cell mapping of upper- and single-tier municipalities in the Greater Golden Horseshoe 47
Appendix 7: Sources and currency dates of data 69

Terms and Definitions

The terms "Greater Golden Horseshoe", "built boundary", "built-up area(s)", "intensification", "intensification target", "designated greenfield area", and "settlement area(s)" are used in this document with the same meaning and definition as in the *Growth Plan for the Greater Golden Horseshoe, 2006*. For convenience, these definitions have been reproduced in Appendix 1 of this document.

Note on Maps and Illustrations

The information displayed in maps and illustrations in this technical paper and its appendices may not be to scale, may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries and designations, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of these maps and illustrations.

Introduction

Places to Grow - A Growth Plan for the Greater Golden Horseshoe

On June 16, 2006, the Government of Ontario released the *Growth Plan for the Greater Golden Horseshoe, 2006* (Growth Plan). It was prepared under the Places to Grow Act, 2005, as part of the Places to Grow initiative to plan for healthy and prosperous growth throughout Ontario.

Figure 1 below shows the extent of the Greater Golden Horseshoe.

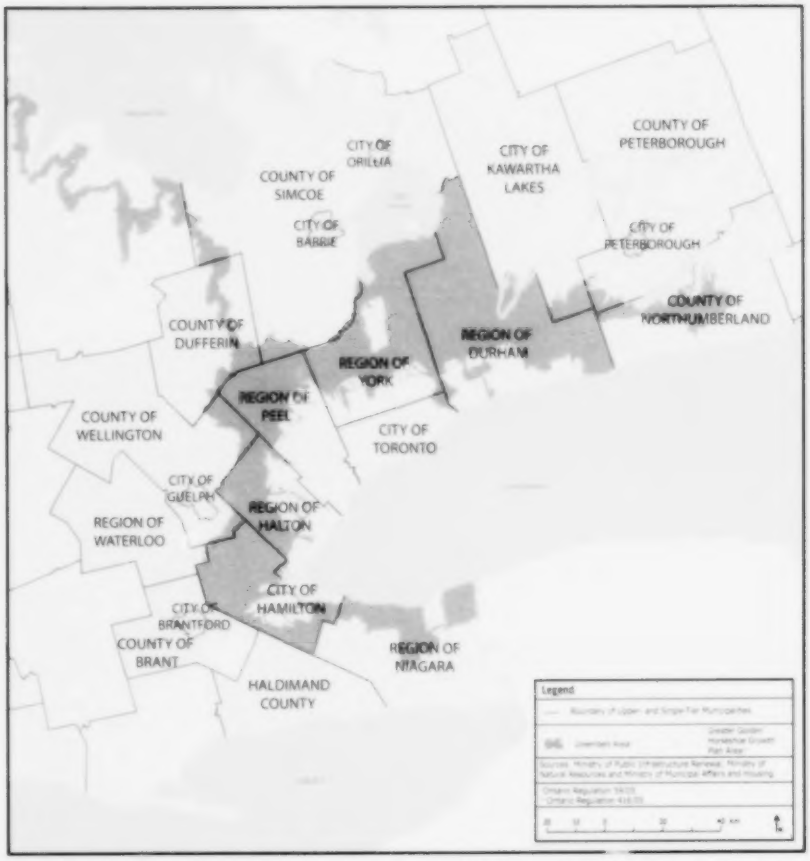

Figure 1: The Greater Golden Horseshoe (source: Schedule 1, the *Growth Plan for the Greater Golden Horseshoe, 2006*).

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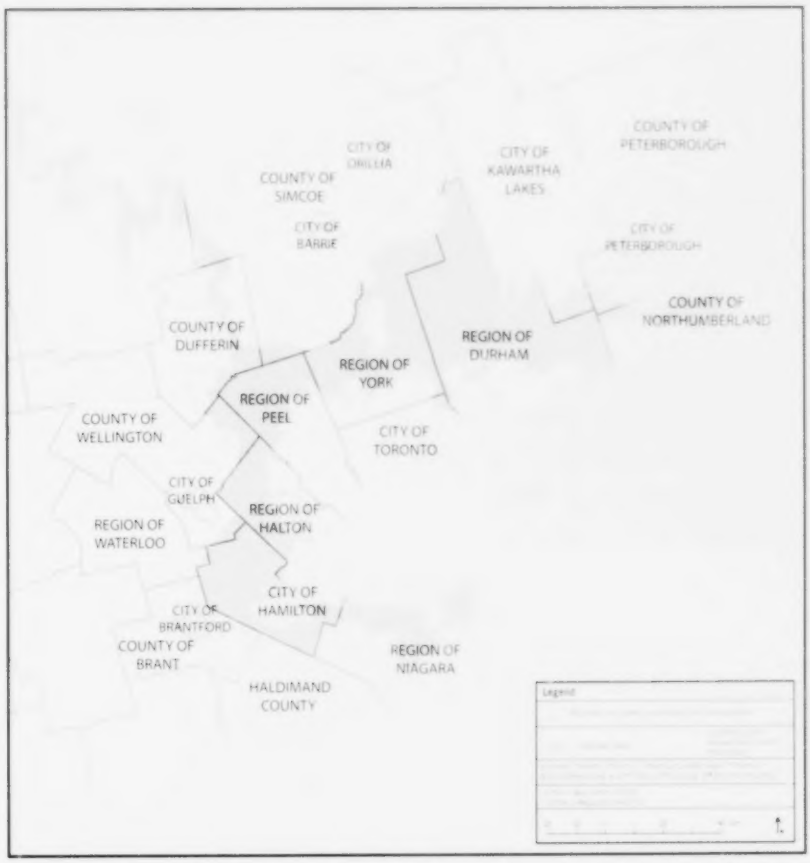


Figure 1: The Greater Golden Horseshoe (source: Schedule 1, the *Growth Plan for the Greater Golden Horseshoe, 2006*).

The Growth Plan aims to:

- Revitalize downtowns to become vibrant and convenient centres;
- Create complete communities that offer more options for living, working, shopping and playing;
- Provide greater choice in housing types to meet the needs of people at all stages of life;
- Curb sprawl and protect farmland and green spaces; and
- Reduce traffic gridlock by improving access to a greater range of transportation choices.

The Built Boundary and the Growth Plan

The Growth Plan supports the creation of more compact, mixed-use and transit-supportive communities in the Greater Golden Horseshoe (GGH). It sets a framework for municipalities to plan for future growth, and direct a significant portion of projected residential and employment growth through intensification to built-up areas.

A key policy regarding intensification in the Growth Plan is the establishment of an intensification target, which specifies that by 2015 and each year thereafter, 40% of new residential development will occur within the built-up area (Growth Plan Policy 2.2.3.1). The built-up area is defined as the area within the "built boundary".

The Growth Plan defines the built boundary as "the limits of the developed urban area as defined by the Minister of Public Infrastructure Renewal in accordance with Policy 2.2.3.5". Policy 2.2.3.5 of the Growth Plan states that the Minister, in consultation with affected municipalities will verify and delineate the built boundary. This technical paper outlines the work to date to identify the built-up area of the GGH, and the proposed next steps to refine and delineate a final built boundary.

The built boundary will be a precise, fixed line for the purposes of implementing and monitoring the intensification objectives of the Growth Plan. It will, by definition, identify built-up areas and designated greenfield areas that are subject to certain Growth Plan policies. The Growth Plan defines the designated greenfield areas as "the area within a settlement area that is not built-up area." The settlement area boundary is defined by the respective official plan.

Figure 2 below illustrates the Growth Plan definitions and terminology used in this paper.

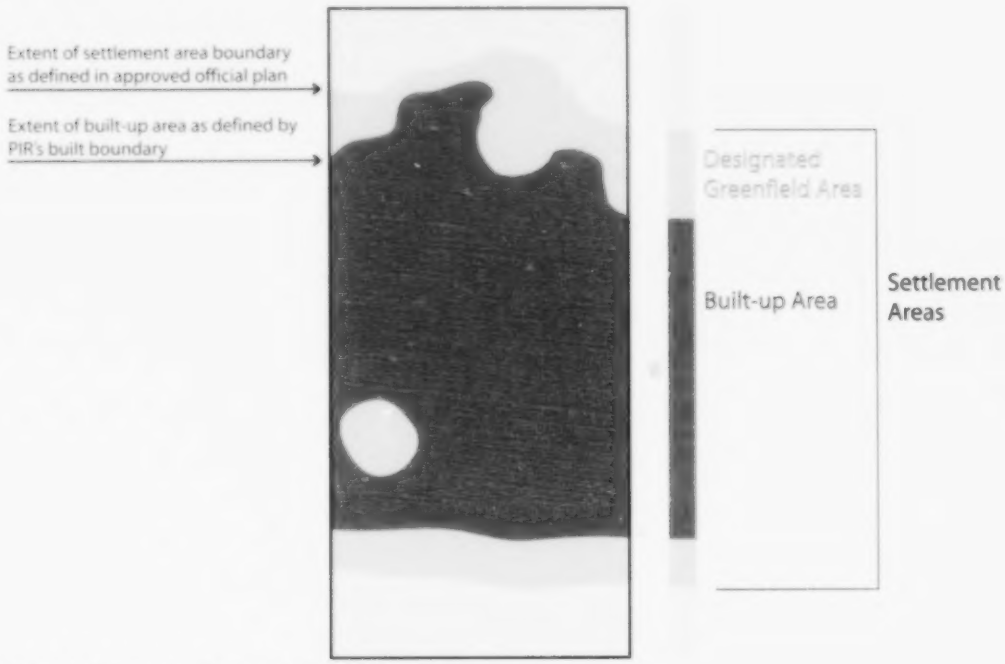

Extent of settlement area boundary as defined in approved official plan
Extent of built-up area as defined by PIR's built boundary
Designated Greenfield Area
Built-up Area
Settlement Areas

Figure 2: Definitions and terminology

It should be noted that the inclusion of lands within the built boundary does not necessarily imply that these lands will be developed or built upon. For example, the inclusion of a park or cemetery in the built-up area does not imply that these lands will be redeveloped. Any development on lands within the built boundary is still subject to the relevant provincial and municipal land-use planning policies. Furthermore, the built boundary is not a land-use description and the delineation of the built boundary will not confer any new land-use designation, nor alter existing land-use designations.

Developing a Built Boundary for the GGH

This paper outlines the approach and methodology that the Ministry of Public Infrastructure Renewal (PIR) has developed in consultation with experts and technical stakeholders for the delineation of a built boundary for the GGH.

This work represents the first time a built boundary has been identified using a consistent methodology for the full geography of the GGH. Some individual municipalities in the GGH have previously identified urbanized areas using various

datasets and differing methodologies, but there has been no uniform approach across the GGH.

Over the past year and a half, PIR has been reviewing existing methodologies, available data sources, and practices used in other jurisdictions by various urban research groups. Different jurisdictions have used a variety of definitions and methodologies for determining the built-up area and defining a built boundary. A bibliography is included in Appendix 2.

The data used to derive the built boundary have been obtained from the Ontario Parcel Alliance (OPA) and the Municipal Property Assessment Corporation (MPAC). The datasets obtained by PIR contain only land-use and parcel number information and do not contain any confidential, personal or financial information. For a detailed description of the two datasets used, please refer to Appendix 3.

This approach to delineate a built boundary balances the need to obtain specific and accurate data to define a meaningful boundary-line and the computational challenge of analyzing 2.4 million parcel polygons, each with multiple land-use records in the compiled MPAC-OPA database.

Throughout this work and at each milestone in developing the methodology, PIR has consulted with technical experts including at least six stakeholder working sessions and dozens of one-on-one meetings. The advice and feedback received was invaluable in the development of the built boundary methodology.

Purpose of this Technical Paper

This paper describes and illustrates a new approach to defining a built boundary, across a large geographic area and for the specific purposes of implementing and monitoring the Growth Plan for the GGH. This approach involves four steps. The first three steps have already been completed by PIR.

This paper includes maps of the built-up areas for each upper- and single-tier municipality in the GGH, at the level of 250m X 250m square grid-cells. Step 4 described in this paper includes a draft set of rules for refining and smoothing the edge of the built grid-cell areas, to delineate a final built boundary that reflects as closely as possible the extent of the built-up area on the ground. This paper is being released for information and for comment, to assist in refining Step 4.

Feedback and Next Steps

We are seeking feedback on the overall approach, but in particular on the final step: the refinement of the built boundary.

Specific areas for feedback and comment include:

- The methodology used to date to generate the map of the built grid-cells
- The ability of the methodology to accurately and consistently represent built-up areas across the GGH
- The proposed rules in Step 4 for refining the built boundary

Over the next few months, PIR will incorporate feedback on this technical paper and work with municipalities and other technical experts to refine and verify the built-up areas. PIR will produce a final built boundary for the GGH for release in 2007.

The final built boundary will be used to monitor and implement the intensification and density targets and policies of the Growth Plan.

Details on how to provide comments to PIR are provided at the end of this paper. Feedback is requested by January 19, 2007.

Key Steps In Identifying Built-up Areas

The next sections outline in detail the methodology developed by PIR to delineate a built boundary for the GGH. The key steps of this methodology are listed in the table below.

Steps 1, 2, and 3 have been completed by PIR. These first three steps involve:

- compiling a geospatial land-use database;
- selecting settlement areas for which a built boundary will be developed; and
- analyzing the datasets to identify built-up areas at a generalized scale as illustrated in the maps in Appendix 6 of this paper.

PIR is seeking feedback on the work to date, as well as the proposed methodology and rules that will be used to refine the grid-cells in Step 4 to define a built boundary.

Work to date

Step 1: Create a parcel land-use database
- 1.1 Select the most appropriate primary datasets
- 1.2 Summarize land-use data into manageable categories for further analysis
- 1.3 Compile the database using primary datasets

Step 2: Select settlement areas for which a built boundary will be developed
- 2.1 Compile settlement area dataset
- 2.2 Establish threshold size and identify settlement areas for which a built boundary will be developed

Step 3: Generate grid-cell mapping for the settlement areas identified in Step 2
- 3.1 Overlay grid-cell matrix on Growth Plan area
- 3.2 Assign one of six summary land-uses to each grid-cell in the Growth Plan area

3.3 Select all cells that fall within settlement areas over the threshold size
3.4 Assign all grid-cells as either built or unbuilt
3.5 Consolidate and aggregate the built grid-cells to approximately identify built-up areas

Next steps to complete the built boundary

Step 4: Apply refinement rules
4.1 Revert from grid-cells to parcels
4.2 Overlay detailed GIS datasets to assist in refinement process
4.3 Apply refinement rules to define a built boundary

Step 1: Create a Parcel Land-Use Database

1.1 Select the most appropriate primary datasets

The first step in developing the built boundary was the selection of appropriate primary data sources, which could be used to identify urbanized areas. A number of basic criteria were used in order to select appropriate datasets. The data needed to be:

- able to track the location and amount of new residential units annually over the life of the Growth Plan;
- consistently available and applicable across the entire GGH;
- able to identify land-use on a consistent, GGH-wide geography to determine built-up uses;
- compatible with local and regional planning practices, and land-use and planning boundaries;
- able to maintain privacy of confidential, property-related information.

The scale of the geographic-unit of the primary datasets was also a critical factor since it would determine the precision and character of the built boundary. The unit of geography used in the analysis, in this case the property parcel, was the building block for the built boundary line.

The primary datasets that met the criteria above were:

1. Tax Roll 2006 MPAC data (current to end of 2005)
   MPAC administers a uniform, province-wide property assessment system, including a database of property types using registered Land Transfer Tax Affidavits. MPAC data is classified into property types or land uses such as commercial, industrial,

residential, farm, multi-residential, and vacant. Step 4 will allow for including built-up parcels that are not captured in the MPAC dataset in the built boundary.

2. OPA data (current to January 2006)
   OPA is jointly maintained by Teranet Enterprises Inc., MPAC and the Ministry of Natural Resources. It contains a standardized, Ontario-wide, geospatial dataset of assessment, ownership and Crown parcels of land. The OPA database includes parcel boundaries, assessment roll numbers, and property identification numbers where applicable.

It is important to note that the OPA and MPAC datasets obtained by PIR contained only land-use, residential unit-count, and parcel number information. The datasets used to develop this methodology, and applied in this analysis, did not contain any confidential, personal or financial information.

For a detailed description of these two datasets, please refer to Appendix 3. For a list of attributes contained in the MPAC dataset obtained by PIR, please refer to Appendix 4.

Other datasets that were evaluated by PIR for their suitability are listed and described in more detail in Appendix 5.

1.2 Summarize land-use data into manageable categories for further analysis

The MPAC dataset contains approximately 300 land use attribute codes. This is more detail than was required for this analysis. These 300 codes were therefore sub-divided into six broader, simplified summary land uses: built, unbuilt, green space unavailable, variable, not a parcel, and unknown. These six summary uses were further reclassified into only built and unbuilt later in Step 3.

Summary land-use	Typical Examples
Built	any residential, commercial, industrial and institutional use.
Unbuilt	rural, forest, farm, or vacant uses.
Green space unavailable	park, conservation area, etc.
Variable	golf course, ski area, quarry, etc. that would be considered built-up when inside a settlement area and unbuilt when outside.
Not a parcel	this land was not identified as a parcel for assessment purposes in the MPAC database. This would include features such as roads, highways, etc.
Unknown	no match possible between an Ontario Parcel and any record on the MPAC files. Of the 2.4 million parcels used in this analysis, only 7,899 parcels, or 0.33 per cent of the total, were unknown.

Please see Appendix 4 for a full list of detailed MPAC land-use codes and their corresponding summary land-use coding.

1.3 Compile the database using primary datasets

The next step was to create an integrated database by linking the parcel number attributes in the two selected datasets in order to combine parcel boundary, residential unit count and land-use information. This combined parcel and land-use database was then used to determine which OPA parcels were considered to be built or unbuilt.

Detailed steps:

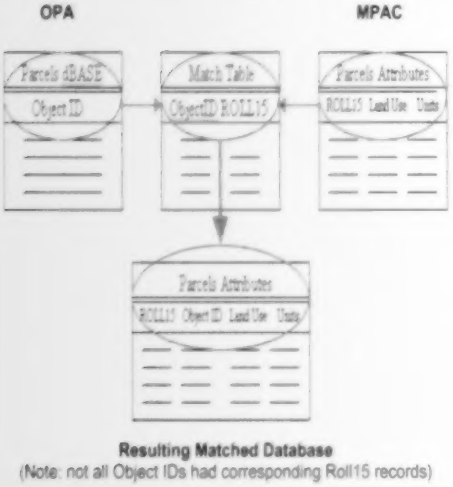


Figure 3: Linking of MPAC and OPA datasets.

(i) MPAC data and OPA datasets were linked to create a database with one record per parcel[1]. Each parcel's land use, geographic boundaries, and residential unit attributes were identified. Figure 3 illustrates the linking process for these two datasets.

(ii) Where records with multiple MPAC land-use codes were assigned to a single parcel (e.g. one parcel could contain both residential and recreational land uses), the parcel was classified as built, provided that at least one of the land-use codes assigned to the parcel had a known built use (e.g. residential).

(iii) A parcel with multiple MPAC land-use codes was classified as unbuilt if all the property codes associated with it were unbuilt land uses.

(iv) Condominium files were aggregated to create parcel level data and not residential unit level data. The unique roll number allowed for identification of which units corresponded to a particular condominium parcel. A separate joining process for condominiums and their associated units was carried out to assign the unit data to its respective parcel.

(v) The number of residential units on each parcel were computed and recorded. This allowed for the calculation in Step 2 of the number of residential units in settlement areas. It will also allow for the development of a baseline count for the number of residential units within the final built boundary, and will assist with tracking new residential units to assess achievement of the Growth Plan's intensification policies.

1 There are approximately 2.4 million OPA parcels in the GGH. This excludes parcels for roads.

Step 2: Select Settlement Areas for which a Built Boundary will be Developed

By definition, the built-up area and built boundary must lie within a settlement area. The Growth Plan aims to direct intensification to settlement areas that can accommodate and service new growth. However, some settlement areas identified in local official plans are small, not fully serviced, and may not be appropriate as a focus for intensification.

A built boundary is to be delineated only for those settlement areas where it is appropriate to apply the Growth Plan intensification target. To distinguish these settlement areas, a threshold size was applied to identify settlement areas for which a built boundary will be developed.

2.1 Compile settlement area dataset

The Ministry of Municipal Affairs and Housing maintains land-use data derived from the latest, approved, publicly available individual municipal official plans. This information was used to compile a dataset of lands in the GGH that were considered settlement areas as defined in the Growth Plan[2]. These lands are designated in the respective official plans for development and urban uses.

2.2 Establish threshold size and identify settlement areas for which a built boundary will be developed

PIR determined that the built boundary would be developed for settlement areas over a size threshold of 400 residential units. The cut-off of 400 residential units translates to approximately 1,000 persons based on an average household size of approximately 2.5 persons per residential unit[3] in the GGH. This is consistent with Statistics Canada's cut-off of 1,000 persons for its definition of an urban area based on international comparative research.

Smaller settlement areas, for which a built boundary is not delineated will, by definition, be subject to the Growth Plan's designated greenfield area policies and target.

2 Settlement areas are defined in the Growth Plan as urban and rural settlement areas within municipalities (such as cities, towns, villages, and hamlets) where development is concentrated and which have a mix of land uses; and where lands have been designated in an official plan for development over the long term planning horizon provided for in the *Provincial Policy Statement, 2005*. Where there are no lands designated over the long-term, the settlement area may be no larger than the area where development is concentrated. This is essentially the same definition as that in the *Provincial Policy Statement, 2005*.

3 The ratio of 2.5 persons per unit is based on Statistics Canada's census findings for 2001.

The following steps were applied to the settlement area dataset to determine which areas met the residential unit count threshold for the development of a built boundary.

(i) Using the parcel land-use database, a count of residential units was run for all parcels contained within each polygon in the settlement area dataset. A parcel was counted inside of the settlement area if its centroid (geographic centre) lay inside the settlement area boundary. Individual settlement areas polygons (e.g. individual towns, hamlets, etc.) were treated separately in the analysis.

(ii) Polygons with 400 or more residential units were then selected.

Settlement Areas with less than 400 units
Settlement Areas with 400 or more units
Agricultural, Rural and other areas
Hydrological Features

Figure 4: Identification of settlement areas for which a built boundary will be developed.

Figure 4 illustrates the application of this threshold to the settlement area dataset. The red polygons on the map represent settlement areas containing fewer than 400 residential units. The pink areas represent settlement areas containing 400 or more residential units which met the threshold and were selected in this step. All settlement areas in the dataset containing fewer than 400 residential units were excluded.

This work was completed in winter 2005, and the settlement areas used in this analysis, and illustrated in the maps in this document, may not necessarily reflect up-to-date, approved municipal land-use and planning boundaries. Some settlement areas may have also been excluded because the dataset may not be fully up to date. The dataset will be updated and corrected based on feedback and input during the consultation/refinement stage.

There will be cases where already-developed lands within an excluded settlement area are adjacent to built-up areas of a settlement area for which a built boundary will be developed. Where these lands are in the same upper-tier municipality, and services and infrastructure are shared with the adjacent settlement area, these adjacent built-up lands may be included within the built boundary.

Step 3: Generate Grid-cell Mapping for the Settlement Areas Identified in Step 2

This third step used the MPAC-OPA database compiled in Step 1 and the settlement areas greater than the threshold size selected in Step 2, to identify and aggregate the land-use information at an approximate, generalized scale.

3.1 Overlay grid-cell matrix on Growth Plan area

A grid-cell matrix was overlaid and used as a base to manage, group, and aggregate millions of land-use and parcel records into matrix cells, making them standardized and manageable for further analysis. The matrix was comprised of 250m X 250m square cells overlaid across the entire Growth Plan area[4].

The approximately 545,000 grid-cells covering the geography of the GGH allowed for the grouping of underlying land-use and parcel codes into each corresponding cell while still being small enough to accurately represent the underlying land use[5]. Using a larger grid-cell would have reduced the accuracy of the methodology. A smaller grid-cell would have greatly increased the computational challenges without any real improvement in the accuracy of the methodology.

Figure 5: Overlay of grid-cell matrix.

Figure 5 illustrates the overlay of the grid-cell matrix on the threshold settlement area base created in Step 2.

3.2 Assign one of six summary land-uses to each grid-cell in the Growth Plan area

Summary land uses identified in Step 1.3 were assigned to grid-cells for the purpose of aggregation and further generalization. This step established whether a cell had enough of a particular summary land use in it to represent that use.

4 (1 cell = 6.25 hectares). This size was chosen as being optimum for both specificity and manageability. As a point of size reference, each cell could contain approximately 200 average single-family residential parcels. Tests done on the grid-cell size indicated that if the cell sizes were much larger, then the analysis would be cruder and less accurate. If the cell sizes were smaller, then the computational challenge would be much greater.

5 Note that tests done in terms of the origin point of the grid-cell network and its impact on the results of the process indicate that moving the grid network would not appreciably alter the analysis.

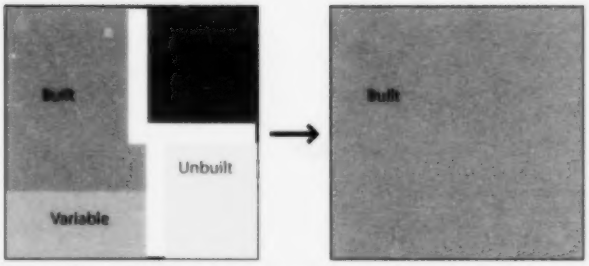


Figure 6: Assignment of dominant summary land-use to a grid-cell

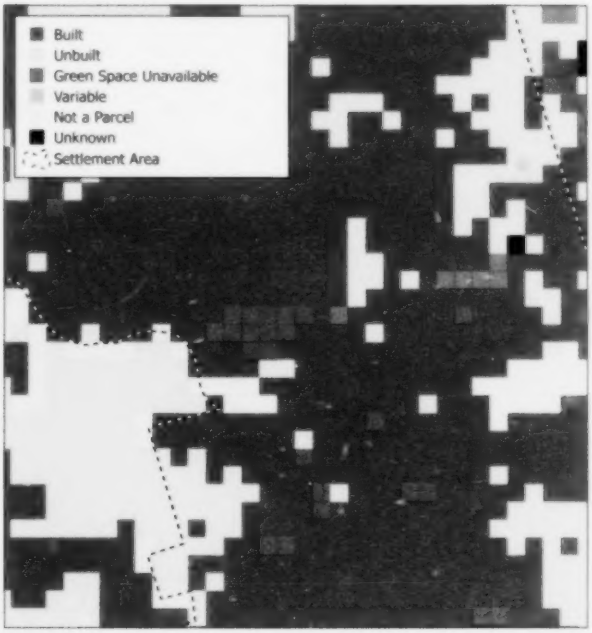


Figure 7: Assignment of dominant land uses to the grid-cell matrix.

(i) The land area of each summary land use in each cell was computed.

(ii) The cell was given the summary land use that had the highest percentage of land area within that cell.

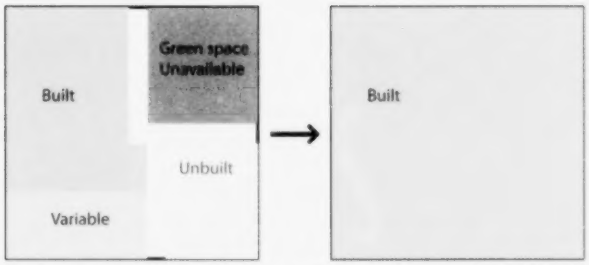
Figure 6 illustrates how the dominant summary land-use of several parcels contained within an individual grid-cell is assigned to that particular grid-cell.

The grid-cells were given one of the six summary uses developed in step 1.2. Figure 7 illustrates the assignment of dominant land uses to the grid-cell matrix.

3.3 Select all cells that fall within settlement areas over the threshold size

This step determined which grid-cells fell within the selected settlement areas for which a built boundary will be developed. Grid-cells and their corresponding summary land uses qualified as belonging to a settlement area if 50 per cent or more of the cell's area lay within the settlement area boundary.

All cells that fell outside the threshold settlement areas, though identified as built in Step 3.2, were dropped from the database and not included in the next steps of the methodology as they lay in settlement areas that had fewer than 400 residential units or lay outside of settlement area boundaries.



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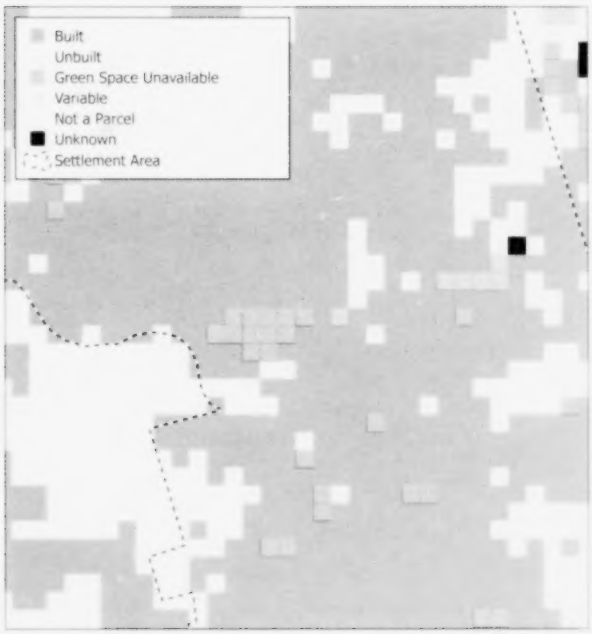

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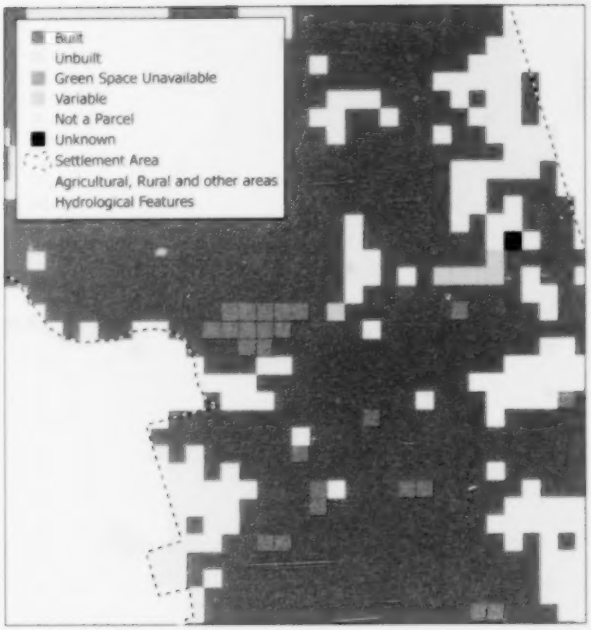


Figure 8: Selection of cells that fall within settlement areas for which a built boundary will be developed.

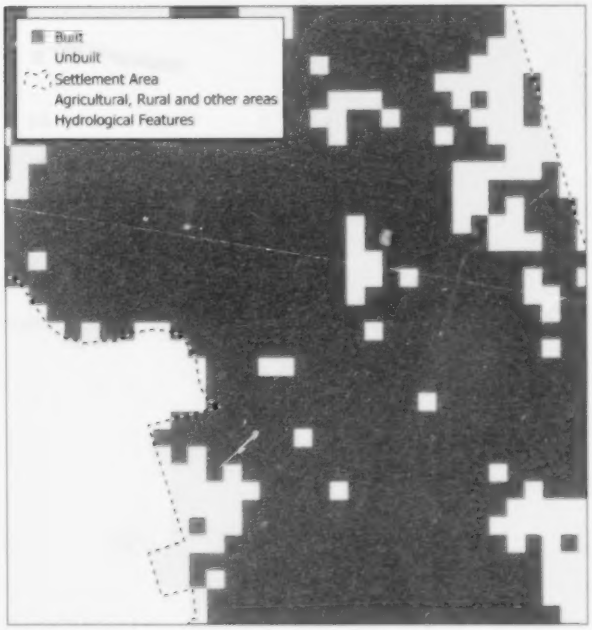


Figure 9: Assignment of six summary land-uses to the two categories of built and unbuilt.

Figure 8 illustrates the selection of grid-cells that fell within settlement areas for which a built boundary will be developed.

3.4 Assign all grid-cells as either built or unbuilt

In this step, summary land uses were further reclassified as either built or unbuilt based on their land-use attributes. Cells coded as variable, no parcel, and greenspace not available, were all converted to built grid-cells. All unknown cells were converted to unbuilt.

This was done to create two broad categories and to identify only those cells that represented built-up areas on the ground, prior to their further generalisation and aggregation in Step 3.5.

Figure 9 illustrates the result of the conversion of the six summary land uses given to cells (illustrated in Figure 8), to the two categories of built and unbuilt.

3.5 Consolidate and aggregate the built grid-cells to approximately identify built-up areas

The result of Step 3.4 included built grid-cells in large, contiguous groupings that represented established built-up areas on the ground, or scattered on the periphery that represented newer, non-contiguous, fringe development.

This step used automated geographic information system (GIS) operations applied in sequence to consolidate built grid-cells representing established built-up areas. This step also linked smaller groupings of built grid-cells, usually representative of patchwork development on the fringe of urban areas which were in the process of being developed, to larger groupings of built grid-cells to make them contiguous. This step also dropped built grid-cells that were scattered or non-contiguous.

The following GIS operations constituted this step:

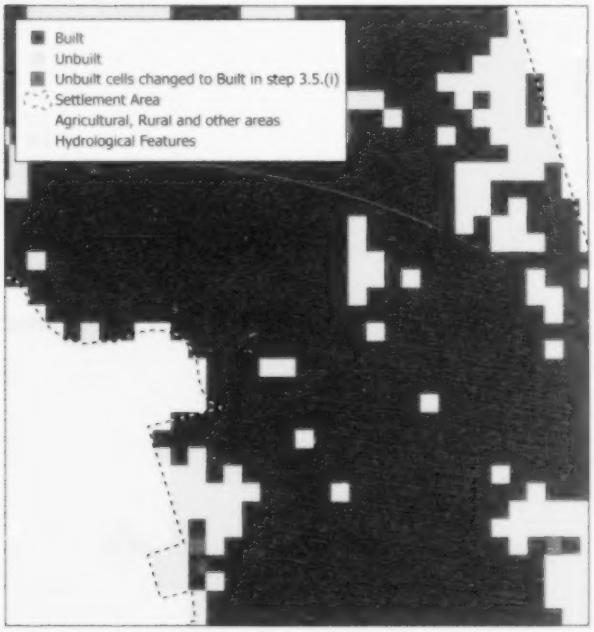


Figure 10: Application of step 3.5.(i) - Joining nearby cells or groups of cells.

Join nearby cells or groups of cells:

(i) If a built grid-cell or group of built grid-cells were separated by only one cell width from another built grid-cell or group of built grid-cells, the one-cell width of unbuilt grid-cell was reassigned as built[6]. Built grid-cells touching on their diagonals were considered to be contiguous and joined to their adjacent cells. The grid-cells reassigned from unbuilt to built are illustrated in Figure 10. This step is intended to include fringe development that is developed enough and close to larger, established built-up areas to be considered contiguous with them.

6 This rule was applied only once for each built grid-cell, meaning that, in a succession of built grid-cells separated by one unbuilt grid-cell, only the first built grid-cell closest to the larger grouping of built grid-cells was joined in order to avoid a "domino" joining effect.

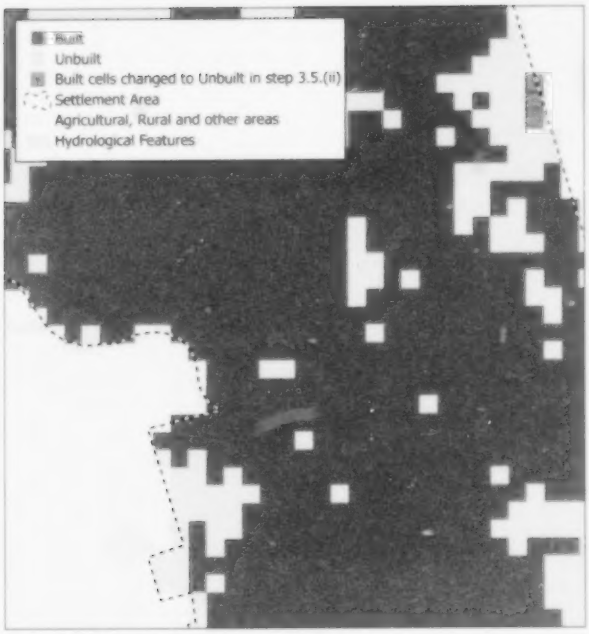


Figure 11: Application of step 3.5.(ii) - Dropping cells or small groups of cells that are further away and on their own

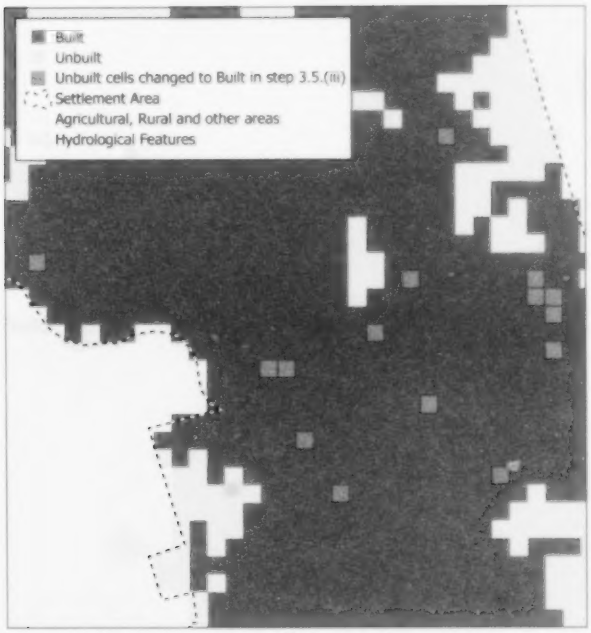


Figure 12: Application of step 3.5.(iii) - Filling in small groups of unbuilt cells that are surrounded by built cells

Drop cells or small groups of cells that are further away and on their own:

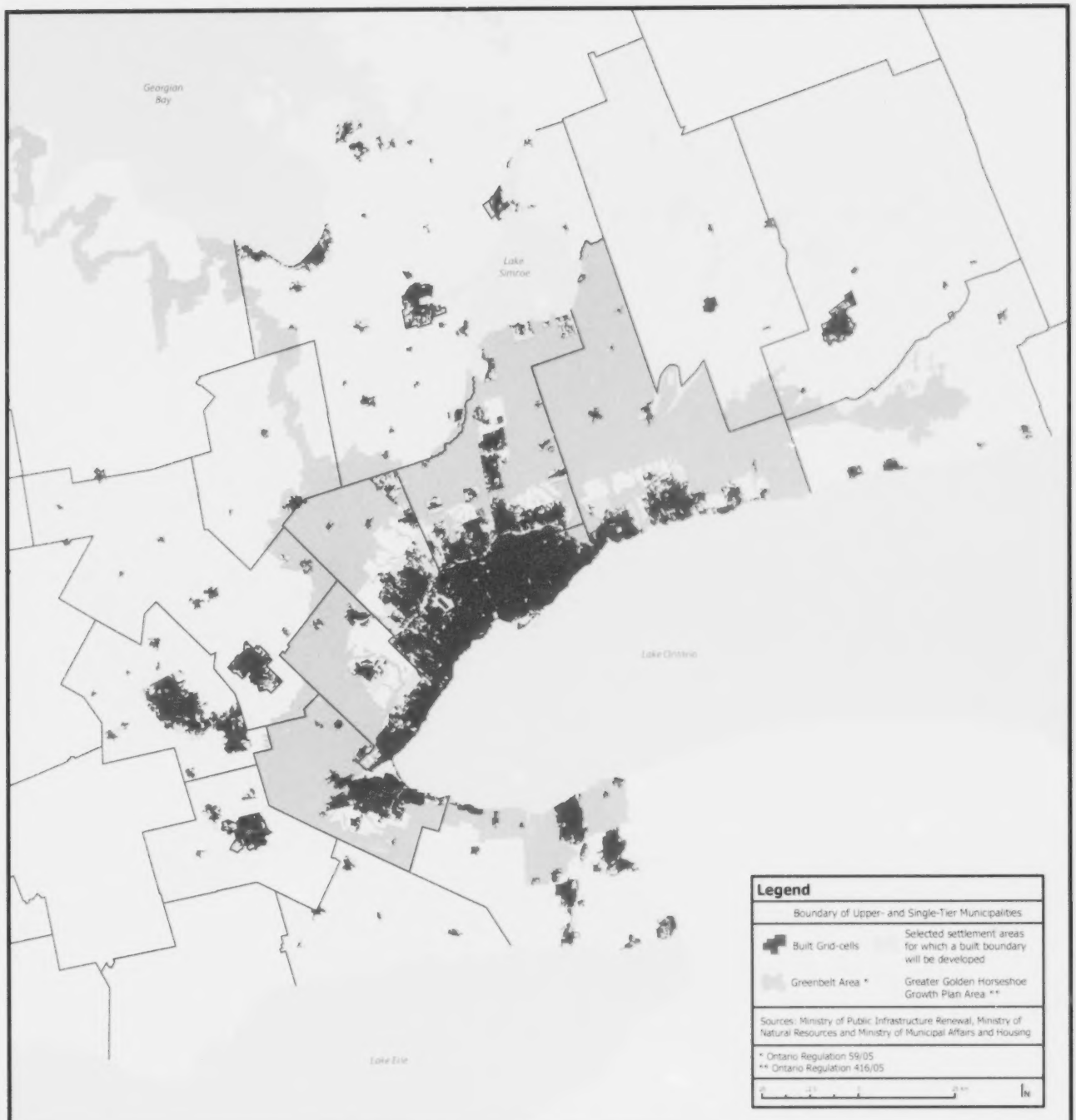
(ii) On completion of Step 3.5.(i) above, separate groupings of fewer than 8 contiguous built grid-cells, containing fewer than 400 residential units, were reclassified as unbuilt grid-cells so as to exclude stand-alone built-up areas that were too small to contribute meaningfully to the intensification objectives of the Growth Plan. Figure 11 illustrates this step.

Fill in small groups of unbuilt cells that are surrounded by built cells:

(iii) On completion of Step 3.5.(ii) above, groupings of less than six contiguous unbuilt grid-cells that were surrounded by built grid-cells, were reclassified as built. This results in a more contiguous built area. Any future development within the small areas added in this step would be supportive of the Growth Plan's intensification objectives. Or, these areas may represent small parks and open areas, the uses of which would remain unchanged if included in the built boundary. Figure 12 illustrates this step.

Figure 13 illustrates the product of Steps 1, 2, and 3. It shows at a generalized scale the coverage of built grid-cells for settlement areas in the GGH for which a built boundary will be developed. Appendix 6 contains the same mapping, at a larger scale, for each individual upper- and single-tier municipality in the GGH. The maps in Appendix 6 are all at the same scale.

Note that the grid-cell maps provided in this technical paper do not constitute the final built boundary. The final built boundary may include areas that are identified as unbuilt on the grid-cell maps. For example, all urban growth centres delineated pursuant to the Growth Plan would be included within the built boundary.


Georgian Bay
Lake Simcoe
Lake Ontario
Lake Erie
Legend
Boundary of Upper- and Single-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05
IN

Built Grid-cell Mapping for the Greater Golden Horseshoe

Figure 13

The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.

Next Steps In Defining A Built Boundary

Steps 1 to 3, described previously, identified aggregated built areas at the level of 250m X 250m grid-cells, within settlement areas above a threshold size. Step 4, outlined in this section, will refine the edges of the grid-cells and delineate the built boundary.

Step 4: Apply Refinement Rules

Refinement is necessary in order to create a built boundary line that is intuitive and can be identified on the ground by corresponding to and aligning with recognizable topographical features and parcel geography. The result of Step 4 will be a precise, identifiable built boundary. This boundary line will allow for the monitoring of future residential development on either side of it and will, by definition, identify built-up areas and designated greenfield areas that are subject to certain Growth Plan policies.

4.1 Revert from grid-cells to parcels

This step of the analysis will revert from the grid-cell matrix established in Step 3, back to the detailed scale of the parcel geography necessary to delineate a built boundary line.

Parcels whose centroids fall within a built grid-cell will be assigned that corresponding cell's use i.e. built or unbuilt. The grid-cell structure is removed, leaving only the OPA parcel fabric with its built and unbuilt attributes. Figure 14 illustrates the built parcels identified as falling within built grid-cells.

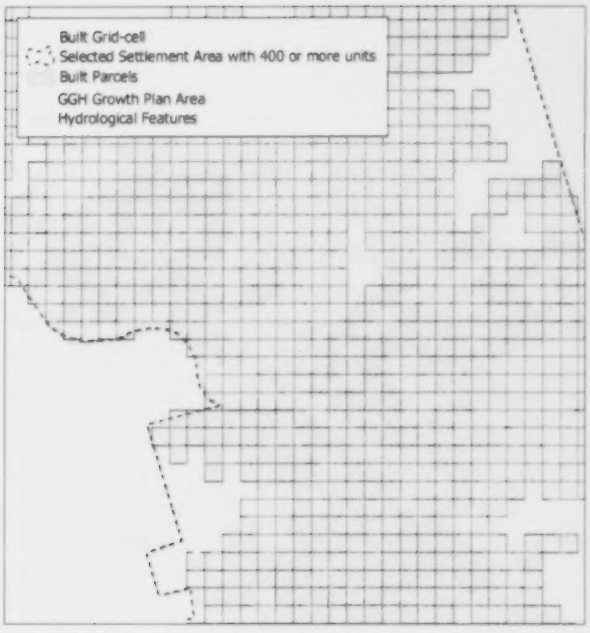


Figure 14: Built parcels identified as falling within built grid-cells

4.2 Overlay detailed GIS datasets to assist in refinement process

Appendix 7 outlines the key GIS datasets that PIR proposes to use as a starting point for the detailed refinement process. They include the detailed OPA-MPAC land-use database compiled in Step 1, aerial and orthophotography, water features, and road network data. These datasets assist the refinement process by making visible parcel and land-use attributes, infrastructure features such as roads and highways, and natural features such as lakes and rivers. PIR, in refining the built boundary with each municipality, will be using more detailed datasets where available, to assist in delineating a precise built boundary.

Figure 15 illustrates the overlay of GIS layers to aid in the refinement process.

4.3 Apply refinement rules to define a built boundary

This step will align the built-boundary line to intuitive and recognizable features such as property parcels, roads, water features, and other physical and infrastructure features. While the process aims to precisely identify the line between built and unbuilt, some built and unbuilt parcels may be included or excluded in order to define a smooth, contiguous and intuitive line.

PIR proposes to apply the following rules in sequence to delineate a built boundary.

(i) **Verify land-uses of parcels:** Prior to proceeding with the steps below, built parcels from Step 4.1, which are known through more detailed local knowledge or data to be unbuilt, may be verified and reassigned as unbuilt. MPAC data may have several land-uses for a single parcel which may result in parcels with predominantly non-urban, unbuilt uses on them appearing as built.

Figure 15: Overlay of various GIS layers to aid in the refinement process.

(ii) **Limit the built boundary to the settlement area boundary:** By definition, the built boundary must lie within a municipal settlement area boundary as delineated in that municipality's approved official plan. When reverting to the parcel geography in Step 4 from the grid-cell geography in Step 3, some parcels may extend beyond or fall outside the settlement areas. In such circumstances, the limit of the settlement area identified in Step 2 will be the limit of the built boundary.

(iii) **Reassign certain unbuilt parcels adjacent to Provincial highways as built:** Unbuilt parcels lying between the built parcel edge and the centre-line of a 400-series provincial highway will be reassigned as being built, if the distance between the nearest built parcel edge and the centre-line of the highway is less than 1km. Otherwise they will remain as unbuilt. Figures 16a and 16b illustrate the base condition and application of this rule (the "before" and "after") respectively.

Figure 16a: Base condition.

Figure 16b: Application of refinement step 4.3.(iii).

(iv) **Align the built boundary with roads and water features:** This rule will align the built boundary with centre lines of roads in the Ontario Road Network (ORN) dataset or with the edges of water bodies in the Statistics Canada Hydrographic Layer, if such roads or water features lie within 100m on either side of the edge of the outermost built-up parcel. The feature (road or water) closest to the edge will take priority. Also, the built boundary should never extend beyond the settlement area boundary as outlined in Step 4.3.(ii) above. Figures 17a and 17b illustrate the base condition and application of this rule (the "before" and "after") respectively. If the road is of the nature of a small crescent or cul-de-sac which does not provide a centre-line to align with, or no road or water body is available within 100 m of the edge, then Step 4.3.(v) should be applied.

Figure 17a: Base condition.

Figure 17b: Application of refinement step 4.3.(iv).

(v) **Align the built boundary with parcel edges if no appropriate roads or water features are present:** If no roads or water features lie within 100m of the edge of the built parcels, the built boundary will be aligned with the edge of the outermost built-up parcel. The built boundary should never extend beyond the settlement area boundary as outlined in Step 4.3.(ii) above. Figures 18a and 18b illustrate the base condition and application of this rule (the "before" and "after") respectively.

Figure 18a: Base condition.

Figure 18b: Application of refinement step 4.3.(v).

(vi) **Treatment of holes in the built-up area:** In order to create a largely contiguous built-up area, groups of unbuilt parcels that are less than 62,500 sq.m. (area of 1 grid-cell or 250m X 250m) and are surrounded on all sides by built parcels, may be included within the built boundary. Figures 19a and 19b illustrate the base condition and application of this rule (the "before" and "after") respectively.

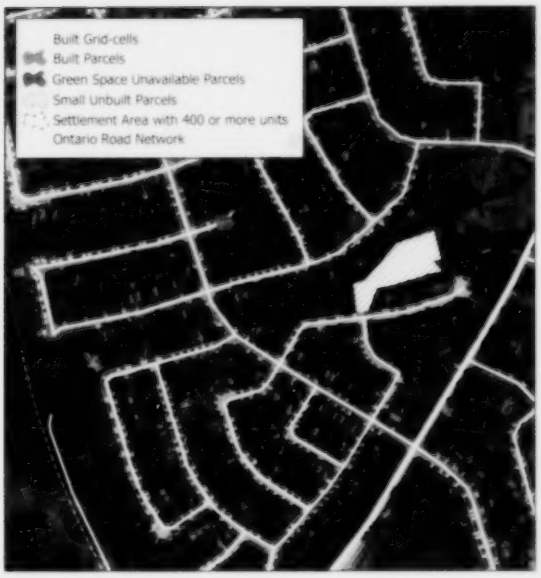


Figure 19a: Base condition.

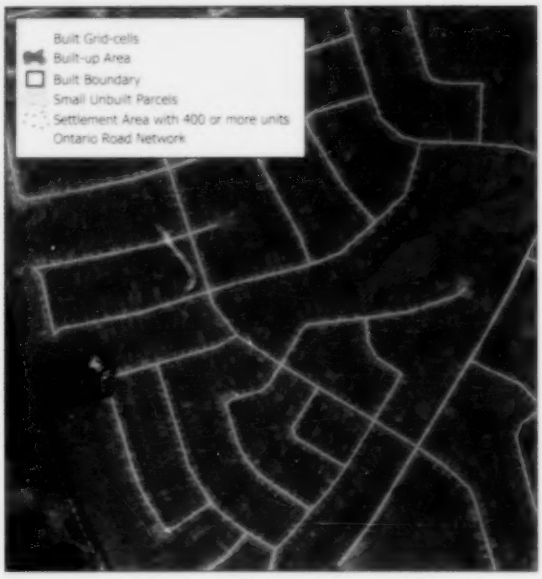


Figure 19b: Application of refinement step 4.3.(vi).

(vii) **Refine the built boundary further with local knowledge of other uses:** As MPAC does not track all ownership patterns and land uses, there may be other land uses on a parcel that may qualify as being built-up and should be included within the built boundary. Land uses that would be included within the built boundary as a result of this rule would be those adjacent to or surrounded by built-up parcels that are:

a. Permanent municipal, federal and provincial parks.
b. Natural heritage features and areas where development is prohibited and which are completely surrounded by built-up parcels.
c. Servicing infrastructure such as water and sewage treatment plans, landfills, water towers etc.
d. Transportation infrastructure such as highways, canals, airports, rail yards, docks etc.

(viii) **Addition of new development prior to Growth Plan effective date:** This overall methodology uses MPAC Tax Roll 2006 data as a cut-off in order to determine what is built-up for the purposes of implementation and application of the Growth Plan policies. This dataset was found to be fairly accurate and consistent for these purposes. However, significant development that may have been built-up prior to June 16, 2006 and that is not captured in the MPAC Tax Roll 2006 may be included, if surrounded by or adjacent to built-up parcels.

Seeking Feedback

This paper has described and illustrated a new approach to defining a built boundary across a large geographic area and for the specific purposes of implementing and monitoring the Growth Plan for the GGH.

Before this process is complete, we are seeking feedback on the overall approach, but in particular on the final step: the refinement of the built boundary.

Specific areas for feedback and comment include:

- The methodology used to date to generate the map of the built grid-cells
- The ability of the methodology to accurately and consistently represent built-up areas across the GGH
- The proposed rules in Step 4 for refining the built boundary

Feedback on this document can be submitted to:

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Director, Growth Policy, Planning and Analysis
Ministry of Public Infrastructure Renewal
Ontario Growth Secretariat
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Fax: 416-325-7403
E-mail: placestogrow@pir.gov.on.ca

For more information please call our toll free line at 1-866-479-9781.

We would appreciate feedback by January 19, 2007.

Appendices

Appendix 1: Definitions

Brownfield Sites
Undeveloped or previously developed properties that may be contaminated. They are usually, but not exclusively, former industrial or commercial properties that may be underutilized, derelict or vacant. (Provincial Policy Statement, 2005)

Built-up Area
All land within the *built boundary*.

Built Boundary
The limits of the developed urban area as defined by the Minister of Public Infrastructure Renewal in accordance with Policy 2.2.3.5.

Designated Greenfield Area
The area within a *settlement area* that is not *built-up area*. Where a *settlement area* does not have a *built boundary*, the entire *settlement area* is considered designated greenfield area.

Geographic Information System (GIS)
A computer system designed to allow users to collect, manage and analyze large volumes of spatially referenced information and associated attribute data.

Greater Golden Horseshoe (GGH)
The geographic area designated as the Greater Golden Horseshoe growth plan area in Ontario Regulation 416/05.

Grid-cell
The 250m X 250m square used to manage, group and aggregate land-use and parcel records for the purpose of analyzing and identifying built-up areas in the methodology outlined in this paper.

Intensification
The development of a property, site or area at a higher density than currently exists through:

a. *redevelopment*, including the reuse of *brownfield sites*;
b. the development of vacant and/or underutilized lots within previously developed areas;

c. infill development; or
d. the expansion or conversion of existing buildings.

(Provincial Policy Statement, 2005)

Intensification Target

The intensification target is as established in Policies 2.2.3.1, 2.2.3.2, 2.2.3.3, and 2.2.3.4.

Parcel

The boundary polygon defining the extents of an individual property as identified and recorded by Teranet Inc. and obtained for this analysis through the Ontario Parcel Alliance.

Redevelopment

The creation of new units, uses or lots on previously developed land in existing communities, including *brownfield sites*. (Provincial Policy Statement, 2005)

Residential unit

A dwelling as identified by the Municipal Property Assessment Corporation for which assessment records are maintained.

Settlement Areas

Urban areas and rural settlement areas within municipalities (such as cities, towns, villages and hamlets) where:

a. development is concentrated and which have a mix of land uses; and
b. lands have been designated in an official plan for development over the long term planning horizon provided for in the Provincial Policy Statement, 2005. Where there are no lands that have been designated over the long-term, the settlement area may be no larger than the area where development is concentrated.

For specific policies, please refer to the *Growth Plan for the Greater Golden Horseshoe, 2006* which can be found at
http://www.pir.gov.on.ca/english/growth/ggh_plan.htm

Appendix 2: Bibliography

Listed below is a partial bibliography of published and unpublished work on defining built-up areas. The analyses and methods in the literature and case studies below apply to varying scales - some at the large scale of a country and others at the very local scale of zoning.

All weblinks cited below were confirmed as active on November 1, 2006.

Batty, Michael Yichun Xie & Zhanli Sun (1999); *The Dynamics of Urban Sprawl;* CASA Working Paper Number 15. Centre for Advanced Spatial Analysis (CASA), University College London.
http://www.casa.ucl.ac.uk/publications/workingPaperDetail.asp?ID=15

Batty, Michael, Elena Besussi, Nancy Chin (2003); *Traffic, Urban Growth and Suburban Sprawl;* CASA Working Paper Number 70. Centre for Advanced Spatial Analysis (CASA), University College London.
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Burchfield, Marcy, Henry G. Overman, Diego Puga, Matthew A. Turner (2003); *Causes of Sprawl: A Portrait from Space;* Working Paper, University of Toronto Department of Economics.

Federal Register (2002); *Urban Area Criteria for Census 2000;* Washington DC, Bureau of Census.

Chin, Nancy (2002); *Unearthing the Roots of Urban Sprawl: A Critical Analysis of Form, Function and Methodology*; CASA Working Paper Number 47. Centre for Advanced Spatial Analysis (CASA), University College London.
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Churchman, Arza (1999); *Disentangling the Concept of Destiny*; Journal of Planning Literature, Vol.13, No. 4, (May) pp.389-411

City of Toronto, (2000); *Clean, Green and Healthy: A Plan for an Environmentally Sustainable Toronto*; Final report of Environment Task Force.
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Australian Department of Primary Industries and Energy / Department of Human Services and Health, (1994); *Rural, Remote and Metropolitan Areas Classification 1991 Census Edition*; Australian Government Publishing Service, Canberra, Commonwealth of Australia.

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Ewing, R., Pendall, R., & Chen, D. (2002); *Measuring sprawl and its impact: the character & consequences of metropolitan expansion*; Washington DC: Smart Growth America.

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Miron, John R (2003); *Urban Sprawl in Canada and America: just how dissimilar?*; University of Toronto at Scarborough.
http://citieslab.utsc.utoronto.ca/Papers/UrbanSprawl.pdf

Mitchell, Bill (2002); Bibliography of Sources; taken from *Compact Cities and Urban Intensification: Desirable, Acceptable, Achievable?*
http://www.vtsprawl.org/Resources/density/Mitchell-density-bib.pdf

Moglen, G.E., S.A Gabriel and J.A. Faria (2003); *A Framework for Quantitative Smart Growth;* Land Development's Journal of the American Water Resources Association; Vol. 39 no. 4, pp.947-959.
http://www.eng.umd.edu/~sgabriel/Research/publications/JAWRA-SmartGrowth.pdf

Northwest Environment Watch (2004); *The Portland Exception. A Comparison of Sprawl, Smart Growth, and Rural Land Loss in 15 US Cities*; Northwest Environment Watch, Seattle, Washington.
http://www.northwestwatch.org (http://www.sightline.org/)

Oregon Health and Science University, (2004); Office of Rural Health; *Definitions of Rural & Assessing Healthcare Needs.*
http://www.ohsu.edu/oregonruralhealth/what_is_rural.html

Rural Doctors Workforce Agency, (2004); *Rural, Remote, Metropolitan Areas Classification.*

San Francisco League of Conservation Voters (2004); *Definitions & Calculations: This View of Density.*
http://www.sflcv.org/density/

Statistics Canada (2001); *Census Dictionary*- Geography Section.
www12.statcan.ca/english/census01/Products/Reference/dict/geotoc.htm

Torrens, Paul M. and Marina Alberti (2000); *Measuring Sprawl- CASA Working Paper Number 27*; Centre for Advanced Spatial Analysis (CASA), University College London. : http://www.casa.ucl.ac.uk/publications/workingPaperDetail.asp?ID=27

United States Census Bureau (2003); *Differences Between the 1990 Census and Census 2000 Urbanized Area Criteria.*

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Waddell, Paul (2000); *Monitoring and Simulating Land Capacity at the Parcel Level*, in *Monitoring Land Supply with Geographic Information Systems: Theory, Practice and Parcel-Based Approaches*; Vernez-Moudon, A. and M. Hubner, eds., John Wiley & Sons, Inc.: New York., (pp. 201-214).

Wassmer, Robert W. (2000); *Urban Sprawl in a U.S. Metropolitan Area: Ways to Measure and a Comparison of the Sacramento Area to Similar Metropolitan Areas in California and the U.S.*; Social Science Research Network.
http://papers.ssrn.com/paper.taf?abstract_id=241975

Zhang, Wanquing, Angella Bowman & Keith Mueller; *Rural / Urban Definitions: Alternatives and Numbers by State*; Nebraska Centre for Rural Health Research.

Appendix 3: Overview and description of MPAC and OPA datasets

For the purposes of this paper, the two datasets which make up the parcel land-use database are referred to as the OPA dataset for the geographic location and outline of each parcel, and the MPAC dataset for the land-use and residential unit count information within each parcel.

Included in these two information sources are geospatial locations, land-use designations and the number of residential units on the property. In theory, the location of every parcel is known, as are its land use and the number of residential units. Shortcomings in data quality mean that not all these attributes are always known or accurate for all of the approximately 2.4 million parcels within the GGH. The datasets do not include a parcel fabric for roads and water bodies.

The OPA and MPAC datasets obtained by PIR contained only land-use, unit count, and parcel number information. The datasets used to develop this methodology and those applied in this analysis did not contain any confidential, personal and financial information. For a list of attributes contained in the MPAC dataset obtained by PIR and used for this analysis, please refer to Appendix 4.

Brief overview of MPAC data

Every municipality in Ontario is a member of the Municipal Property Assessment Corporation (MPAC), a non-share capital, not-for-profit corporation whose main responsibility is to provide its customers – property owners, tenants, municipalities, government and business stakeholders – with property assessments. MPAC administers a uniform, province-wide property assessment system based on current value assessment in accordance with the provisions of the Assessment Act.

MPAC receives all the registered Land Transfer Tax Affidavits (LTTA) within the Province of Ontario. Upon receipt of this information, MPAC investigates and codes this information into its database.

MPAC data is classified into nine key property types:

- Commercial
- Industrial
- Residential
- Farm
- Multi Residential
- Managed Forest
- Pipeline

- Special and Exempt
- Vacant Land

Within each of these types, the following fields were used for compiling the database used to create the built boundary:

- Assessment Roll number
- Property code
- Property code description
- Location address including postal code
- Site Area
- Site Area Unit of measure (Acres or SF)
- Realty Tax Class
- Realty Tax Qualifier
- Number of residential units for:
  - Muti-residential properties
  - Non-residential properties

Brief overview of OPA data

The Ontario Parcel Alliance (OPA) has been created jointly by Teranet Enterprises Inc., MPAC and the Ministry of Natural Resources.

The OPA data is a standardized, Ontario-wide, geospatial dataset of assessment, ownership and Crown parcels of land. The OPA database includes parcel boundaries, assessment roll numbers, and property identification numbers where applicable.

The OPA data consists of three parcel layers - assessment, ownership and Crown. Of these, the assessment and Crown layers were used in the creation of a built boundary.

Assessment parcels are areas defined by a boundary and an assessment roll number (ARN), for property assessment purposes as determined by MPAC. The assessment parcel is mapped for the entire province. Crown Land Parcels are those owned by the Crown, and are also mapped for the entire province, except in areas where more detailed sub-ownership mapping already exists.

Benefits and challenges in using MPAC and OPA datasets for determining a built boundary for the GGH

While the MPAC and OPA datasets have been selected as the most appropriate and useful to identify a built boundary for the GGH, the data is not without its challenges.

The key reasons why the MPAC and OPA data are most appropriate are:

- Data is available in a consistent format for the entire geography of the GGH.
- Data is updated regularly and is available annually at a minimum.
- GGH upper-, single- and lower-tier municipalities have full access to these datasets.
- Data tracks residential units each year, which allows for measurement of the Growth Plan intensification target

Challenges in using this data have included:

- Currency of MPAC data can vary across the GGH. Municipalities report that the data can be as many as two years out of date and that there are errors. The primary reason for this is that the reporting processes can take time since there is often a need for individual validation of records.
- There are some challenges in simply building a combined dataset that has the land use, the number of residential units and the parcel boundaries on it. Part of this is the historical way the files have been built since many uses are made of the same property and thus multiple files have been developed. In addition, linking files between the two datasets can be challenging. These issues are addressed in Step 1 of the methodology.
- There is no parcel or land-use information for roads and highways.
- Land use data on the parcel records may not fully reflect the actual use of the land. There are also often multiple uses on single parcels and though MPAC records list primary and secondary uses, these may not reflect all the actual uses on the parcel. An example of this can be commercial and industrial land where some owners may own more land than they have yet to develop.

The consultation and verification process to refine a final built boundary is intended to identify and address such shortcomings in the datasets.

Implications with regard to sub-division developments

The use of parcel data according to their recorded land use by MPAC means that land that has been approved for development, such as registered sub-divisions, but is not yet built, will be considered unbuilt. Similar situations involve newly-built condominium structures. Depending on the size of such an area, it will be included or excluded from the built boundary. How it is ultimately identified and defined is dependent on the application of Step 3. Parcels that are occupied and built-up prior to June 16, 2006, the effective date of the Growth Plan, that are not captured in the MPAC dataset and thus not included as part of this analysis, will be accounted for in Step 4 (viii) of this methodology.

Appendix 4: Assignment of summary land-use codes to MPAC property codes

Property Code	Number of Parcels	B-Built UB-Unbuilt GNA-Greenspace Not Available V-Variable	Description
000	10,778	U	Not matched - unknown
100	129,361	UB	Vacant residential land not on water
101	1,871	UB	Second tier vacant lot
102	1,998	GNA	Land of a Conservation Authority
103	3,892	GNA	Municipal park (excludes Provincial & Fed parks)
105	5,604	UB	Vacant commercial land
106	6,363	UB	Vacant industrial land
107	102	GNA	Provincial park
108	15	GNA	Federal park
109	180	UB	Recreational land not on water
110	4,907	UB	Vacant residential/recreational land on water
111	93	UB	Island under single ownership
112	717	UB	Multi-residential vacant land
113	35	UB	Condo development land res
114	4	UB	Condo development land non-res
115	37	B	Dev in progress existing structure
120	523	GNA	Water lot (entirely under water)
125	1,257	UB	Residential development land
127	330	B	Townhouse block freehold
130	2,415	B	Non-buildable land (walkways etc)
134	100	GNA	Land designated and zoned open space
140	29	GNA	Common land
169	173	UB	Vacant land condo res
200	19,644	UB	Farm property without any buildings (no structures may exist)
201	3,993	UB	Farm with residence (with or without secondary structures) but no farm buildings
210	4,093	UB	Farm without a residence but has outbuildings (farm and/or secondary structures)
211	27,977	UB	Farm with a residence (with or without secondary structures) and farm outbuildings.
220	214	UB	Farm without a residence but having a commercial/industrial operation

221	1,413	UB	Farm with a residence and having a commercial/industrial operation
222	103	UB	Farm with a winery
223	11	UB	Grain/feed seed operation
224	263	UB	Tobacco farm
225	1	UB	Ginseng farm
226	4	UB	Exotic farms
228	48	UB	Farm with gravel pit
229	1	UB	Farm with campground etc
230	158	UB	Intensive farm operation without a residence
231	587	UB	Intensive farm operation with a residence
232	136	UB	Large scale greenhouse op
233	25	UB	Large scale swine op
234	345	UB	Large scale poultry op
235	33	UB	Government Agriculture research
240	1,171	UB	Managed forest property vacant not on water
241	49	UB	Managed forest property vacant on water
242	176	UB	Managed forest property seasonal res not on water
243	42	UB	Managed forest property seasonal res on water
244	1,305	UB	Managed forest property residence not on water
245	30	UB	Managed forest property residence on water
260	2,578	UB	Vacant residential/commercial/industrial owned by a non-farmer with a portion being farmed.
261	16,365	UB	Land owned by a non-farmer improved with a non-farm residence with a portion being farmed.
262	249	UB	Land owned by a farmer improved with a non-farm residence with a portion being farmed.
301	1,589,271	B	Single family detached (not on water)
302	2,343	B	More than one structure used for residential purposes with at least one of the structures occupied permanently
303	4,031	B	Residence with a commercial unit
304	1,665	B	Residence with a commercial/industrial use building
305	46,906	B	Link home
306	5	B	Boathouse with a residence above
307	4	B	Community lifestyle
309	81,745	B	Freehold townhouse/row house
311	206,851	B	Semi-detached residential use (includes true semi and single semi links)
313	13,380	B	Single family detached on lake or river
314	184	B	Clergy residence

322	3,311	B	Semi-detached with both units under one ownership
332	35,261	B	Residential property with 2 self-contained units (typically a duplex) (1)
333	11,129	B	Residential property with 3 self-contained units (1)
334	4,272	B	Residential property with 4 self-contained units (1)
335	1,357	B	Residential property with 5 self-contained units (1)
336	2,139	B	Residential property with 6 self-contained units (1)
340	7,972	B	Multi-residence with 7+ ex row
341	670	B	Multi-residence with 7+ with some commercial
350	358	B	Row Housing with 3-6 units under same owner
352	892	B	Row Housing with 7+ units under same owner
360	1,406	B	Rooming or boarding house
361	129	B	Bachelorette 7+
363	228	B	Housekeeping Cottages no American plan
364	2	B	Housekeeping Cottages <50% American plan
365	499	B	Group Home as defined in the Municipal Act
366	790	B	Student housing off-campus
369	49	UB	Vacant land condo res improved
370	5,103	B	Residential Condominium
371	1	B	Life Lease - No Redemption (no or limited redemption amounts)
372	61	B	Life Lease - Return on Invest (guaranteed return or market value based return on investment)
373	104	B	Cooperative Housing - Equity
374	643	B	Cooperative Housing - Non-equity
375	27	B	Co-ownership
378	1	B	Res leasehold condo corp
380	115	B	Res phased condo corp
381	170	B	Mobile Home - one or more homes on a parcel of land which is not a mobile home park operation.
382	100	B	Mobile Home Park - more than one mobile home on a parcel of land which is a mobile home operation.
383	748	B	Bed and Breakfast establishment (predominant use)
385	7	B	Time-share fee simple
391	19,345	B	Seasonal/Recreational Dwelling(s) - first tier on a lake or river
392	4,202	B	Seasonal/Recreational Dwelling(s) - second tier to water
395	7,971	B	Seasonal/Recreational Dwelling(s) - not associated with a lake or a river
400	1,656	B	Small Office Building

401	393	B	Small Medical/Dental Building single tenant
402	2,822	B	Large Office Building
403	377	B	Large Medical/Dental Building
405	2,643	B	Office Use Converted from House
406	853	B	Retail Use Converted from House
407	43	B	Lumber yard
408	199	B	Beer/LCBO
409	723	B	Retail one story >10k sf
410	7,771	B	Retail one story < 10k sf
411	968	B	Restaurant - Conventional
412	356	B	Restaurant - Fast Food
413	78	B	Restaurant - Conventional Nat Chain
414	668	B	Restaurant - Fast Food nat Chain
415	137	B	Cinema/Movie House/Drive-in Theatre
416	9	B	Concert Hall/Live Theatre
417	25	B	Entertainment complex with cinema
419	3	B	Auto service 400 series highways
420	1,971	B	Automotive Fuel Station with or without service facilities
421	3,113	B	Speciality Automotive Shop/Auto Repair/Collision Service/Car or Truck Wash
422	791	B	Auto Dealership
423	237	B	Auto Dealership indep dealer or used vehicles
425	370	B	Neighbourhood shopping centre with anchor
426	26	B	Small box shopping centre
427	89	B	Big box shopping centre
428	83	B	Regional Shopping Centre
429	139	B	Community Shopping Centre
430	2,981	B	Neighbourhood Shopping Centre no anchor
431	16	B	Department/Discount Store
432	639	B	Banks and similar financial institutions < 7,500 sf
433	58	B	Banks and similar financial institutions > 7,500 sf
434	234	B	Freestanding supermarket
435	78	B	Large retail building centre
436	184	B	Freestanding large retail >30,000 sf
438	156	B	Neighbourhood shopping centre with offices
441	344	B	Tavern small hotel
444	167	B	Full service hotel
445	141	B	Limited service hotel
447	2	B	Condo hotel unit

450	471	B	Motel (other than seasonal)
451	14	B	Seasonal Motel
460	20	B	Resort Hotel
461	1	B	Resort Lodge
462	45	B	Country inns and small inns
465	18	V	Child/Community camp/resort
470	120	B	Multi-type complex - defined as a large modern complex having multi-residential (seven units or more) and/or condominium together with co
471	19,615	B	Retail with residential unit(s) (above or behind)
472	623	B	Retail with office(s)
473	582	B	Retail with more than one non-retail use
475	195	B	Commercial condominium
476	6	B	Commercial condominium live/work
477	1,110	B	Retail with office <10,000
478	209	B	Retail with office >10,000
480	1,116	B	Surface parking lot ex fac
481	51	B	Parking garage - not associated.
482	95	B	Surface parking lot in conj
483	1	B	Parking garage - in conj
486	236	V	Campground
487	20	UB	Billboard
489	27	V	Driving range - not part of course
490	573	V	Golf course
491	32	V	Ski resort
492	111	B	Marina - on waterfront defined as a commercial facility for the maintenance
493	10	B	Marina - not on waterfront defined as a commercial facility for the maintenance
495	102	B	Communication tower
496	511	B	Communication buildings or communication structures
500	8	UB	Mine active
501	2	UB	Mine inactive
505	1	B	Saw/lumber mill
510	217	B	Heavy manufacturing ex auto
511	8	B	Pulp and Paper mill
512	61	B	Cement/asphalt manufacturing plant
513	116	B	Steel Mill
514	35	B	Automotive assembly/automotive parts manufacturing plant

515	4	B	Shipyard/drydock
516	7	B	Auto parts
517	17	B	Speciality steel
518	3	B	Smelter ore processing
520	14,386	B	Standard industrial properties not specifically identified by other Industrial
521	14	B	Distillery/brewery
522	45	B	Grain handling (including transfer elevators
523	33	B	Grain handling primary elevators
525	1	B	Process elevator
527	11	B	Abattoir/slaughter/rendering
528	5	B	Food processing
529	7	B	Freezer plant/cold storage
530	2,877	B	Warehousing
531	255	B	Mini-warehousing
532	1	B	Dry cleaning plant
535	1	B	Research and development facilities
540	4,055	B	Other industrial (all other types not specifically defined)
544	4	B	Truck terminal
545	16	B	Major distribution centre
550	2	B	Petro-chemical plant
551	4	B	Oil refinery
553	1	B	Bulk Oil/fuel distr
555	9	B	OPG hydraulic generating station
556	4	B	OPG nuclear generating station
558	395	B	Hydro One transformer station
560	678	B	MEU transformer station
561	2,250	B	Hydro One right-of-way
562	8	B	Private hydro right-of-way
563	16	B	Private hydraulic generating station
565	1	B	Private generating station (fossil fuel and Cogen)
566	20	B	Private transformer station
575	644	B	Industrial condominium
580	2,960	B	Industrial mall
588	83	B	Pipelines transmission
589	194	B	Compressor station distr gas
590	1,211	B	Water treatment pumping
591	1	B	Sewage/waste disposal (treatment)
592	9	B	Dump/transfer/incineration/land fill

593	782	B	Gravel pit
594	5	UB	Peat moss op
595	4	B	Heat or steam plant
596	6	B	Recycling facility
597	2,365	B	Railway right of way
598	253	B	Railway buildings
599	115	B	GO transit station/yard
601	214	B	Post secondary education - university
602	78	B	Multiple occupancy education institutional residence located on or off campus (e.g. Dormitories) Apartments or fraternity/sorority houses
605	3,474	B	School (elementary or secondary
608	153	B	Day care/nursery
610	144	B	Other educational institutions (e.g. schools for blind
611	259	B	Other institutional residences
621	157	B	Hospitals
623	10	B	Continuum of care seniors
624	24	B	Retirement/nursing homes
625	307	B	Nursing homes
626	344	B	Old age/retirement home
627	7	B	Other health care facility (e.g. Clarke Institute)
630	3	B	Federal Penal institution
631	23	B	Provincial Penal institution
632	7	B	Other Penal institution
700	649	B	Place of worship - with clergy res
701	4,002	B	Place of worship - without clergy res
702	1,016	B	Cemetery
703	2	B	Cemetery with non-internment
705	271	B	Funeral home
710	433	B	Recreational non-commercial sport club (ex golf and ski)
711	48	B	Bowling alley
713	3	B	Casino
715	14	B	Race track - auto
716	9	B	Race track horse with slots
718	75	B	Exhibition grounds/fair grounds
720	368	B	Commercial Sport complexes/pools/arenas/stadiums
721	68	B	Non-Commercial Sport complexes/pools/arenas/stadiums
722	1	B	Professional sports complexes
725	20	B	Amusement park
726	14	B	Amusement park large regional

730	131	B	Museum and art gallery (non-profit)
731	235	B	Library and literary institutions
733	9	B	Convention conference centre
734	38	B	Banquet hall
735	716	B	Assembly hall
736	874	B	Clubs private
739	18	B	Local gov't airport
740	9	B	Airport leasehold
741	4	B	Airport Authority
742	152	B	Public transportation facility
743	4	B	International bridge/tunnel
744	15	B	Private airport hangar
745	4	B	Recreational airport
746	49	B	Subway station
748	9	B	Transit garage
749	14	B	Public Transport - other
750	7	B	Scientific/pharmaceutical/medical research facility
755	1	B	Lighthouses
760	20	B	Military base or camp
761	20	B	Armoury
762	1	B	Military education facility
805	154	B	Post Office
806	5	B	Postal; mechanical sorting facility
810	459	B	Fire Hall
812	42	B	Ambulance Base
815	93	B	Police Station
828	12	B	Gov't research pred offices
832	1	B	Gov't canals & locks
840	12	B	Port authority - port activities
842	12	B	Port authority - other activities
	2,414,229		

Source: MPAC, May 2006

Appendix 5: Other data sources evaluated for the proposed built boundary methodology

Various sources were examined for comprehensiveness, applicability to the policy application of a built boundary for the purposes of the Growth Plan, level of geographic detail, currency of the data, accuracy of the data, availability of the data and its expected availability over time.

Statistics Canada's quinquennial census data

This is the most exhaustive source of demographic information available for very local areas of geography. Statistics Canada does define the 'urban area' for every urbanized place in Canada. The geographic specificity of the data as stored and as published is too broad in areas that are on the fringe of the urban area. Fringe area boundaries encompass extensive areas of undeveloped land and thus this data is inappropriate for the level of detail required to measure the objectives of the Growth Plan.

Private sector annual updates of the census data

A number of companies in Canada prepare annual 'updates' of the Census on the same geographic basis as the Census is published. These data are not based on actual fieldwork but are based on models developed using data trends at larger levels of geography and thus do not necessarily reflect actual changes on the ground. They also have the same geographic challenges as Statistics Canada data.

Canada Post

Canada Post maintains a count of residential and business delivery points for every postal code in Canada and updates these counts on a monthly basis. A residential delivery point is very similar to the household concept used by the Census and is also very similar to a residential unit as used to measure intensification in the Growth Plan. However, the geography of postal codes on the fringes of urban areas and in rural areas is inexact and very large and thus cannot be used for defining a built boundary.

Utilities

Electric, gas and telephone utilities keep track of where their customers are located. Theoretically, this information could be assembled into a database that would permit an addressed-based dataset to be compiled that could be used to define built-up areas. Unfortunately, there is no such compilation and the prospects of being able to work

with all the organizations involved to derive such a composite database, even within one utility sector, are unlikely. There would also be no guarantee that the information would be available annually. Geographic boundaries may also vary from utility to utility.

Aerial and satellite imagery

The automated and/or manual analysis of aerial and satellite imagery for defining urban areas has become a well-recognized and commonly accepted method for defining the urbanized extent of a city or a large region. The methods and data sources involved are complex. They are publicly available but are rarely undertaken over large tracts of areas. There are also some accuracy issues and a significant amount of ground validation is needed. The key shortcoming is that this approach has no direct ability to count one of the Growth Plan's key measures, that of residential units (since under any one rooftop visible on aerial photos could be very few or very many residential units). Also, while the approaches can differentiate between urban and non-urban uses, they have difficulty in differentiating different types of unbuilt land within existing urban uses (conservation areas from golf courses from parks etc). Such differentiation is important in setting where boundaries should actually be drawn.

Importantly, these images are the best indication of what is actually happening on the ground since they represent a real-life 'picture' at a point in time. They can also be repeated at regular intervals and can be expected to be available for the life of the Growth Plan. They will always be useful sources of information for refining a built boundary, but would not be used as the primary source for defining it.

Planning designations and related records

Most planning departments keep track of the use of land within their jurisdiction. They use a variety of data sources and organize and display the information according to their own particular needs. Land-use classifications can vary as can the determination of what the land is currently being used for as compared to what the land is zoned for. In many cases, actual geographic limits of a use are not pinpointed – only an approximation of the location and size. The currency and update schedules for these maps and data can vary. Also, these efforts focus on land and usually do not include a count of the number of residential units involved.

Some attempts have been made to assemble a composite picture of land-use planning designations across all the jurisdictions in the GGH but none has yet been assembled that covers all municipalities in the GGH. The Ministry of Municipal Affairs and Housing has a process in place to assemble a composite map that shows where urban

land-use is permitted according to official plans. However, this project does not identify where development currently exists.

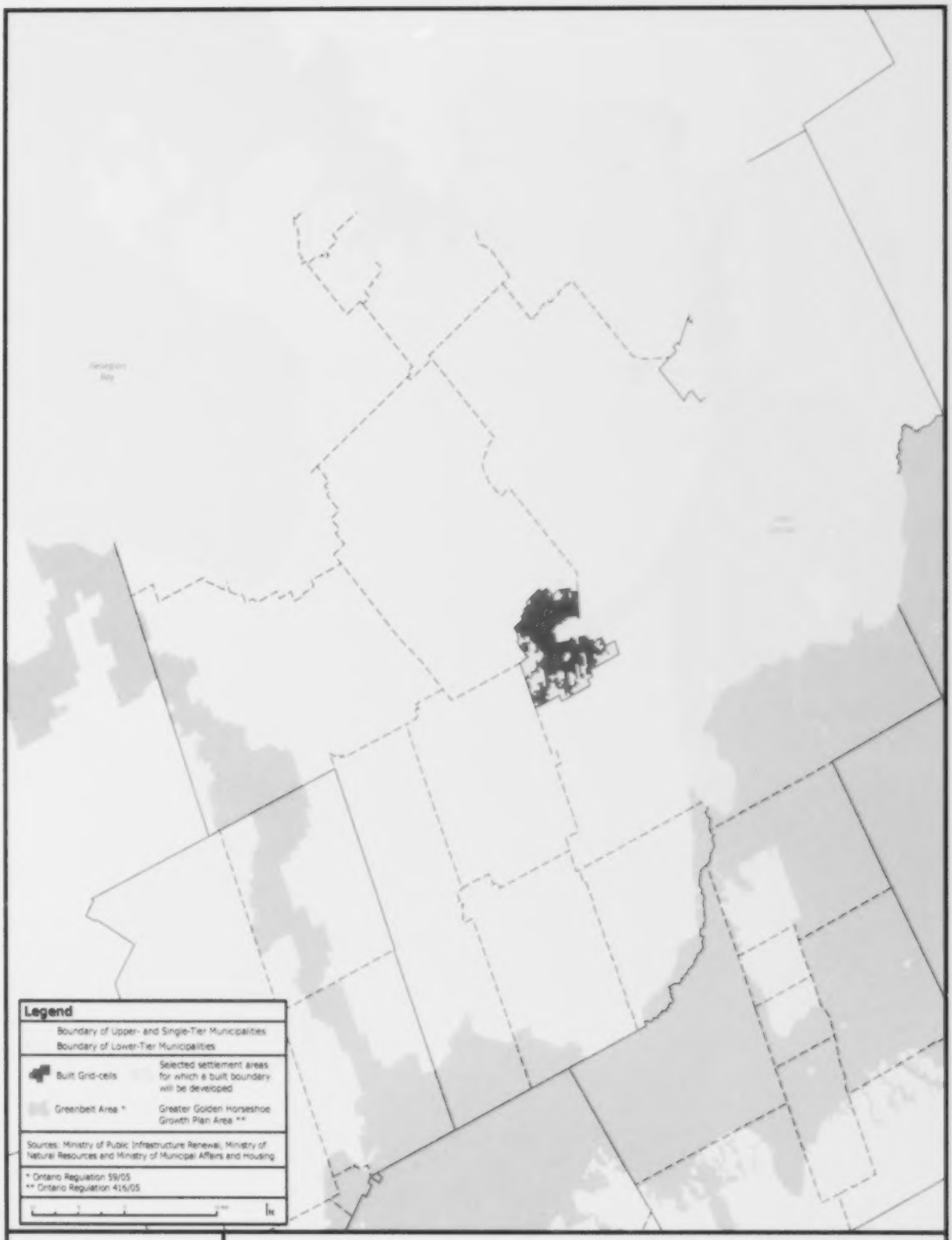
Therefore, at this time, compiling a composite picture of existing land-use across the entire GGH based on planning information and that includes a count of residential units cannot be done.

Building permits and housing starts and completions

Since new residential units and most sizeable conversions require building permits, a system that tracks where these permits are located and then monitors them through to completion (starts and completions) could be used to identify built-up areas. Following building permits through to construction is important since it should be noted that many permits are issued that are subsequently not used to build or to convert a residential unit. At this time, no such consistent, composite monitoring is done across the entire GGH. Very few municipalities geocode their building permits – that is assign a latitude and longitude position for each permit. It also appears that even fewer municipalities then track by location the start and completion of the new building and/or conversion. No provincial or federal organization does this. CMHC and Statistics Canada collect summary statistical information from local authorities but it is at the scale of each municipality. Thus this approach cannot be used.

Appendix 6: Built grid-cell mapping of upper- and single-tier municipalities in the Greater Golden Horseshoe

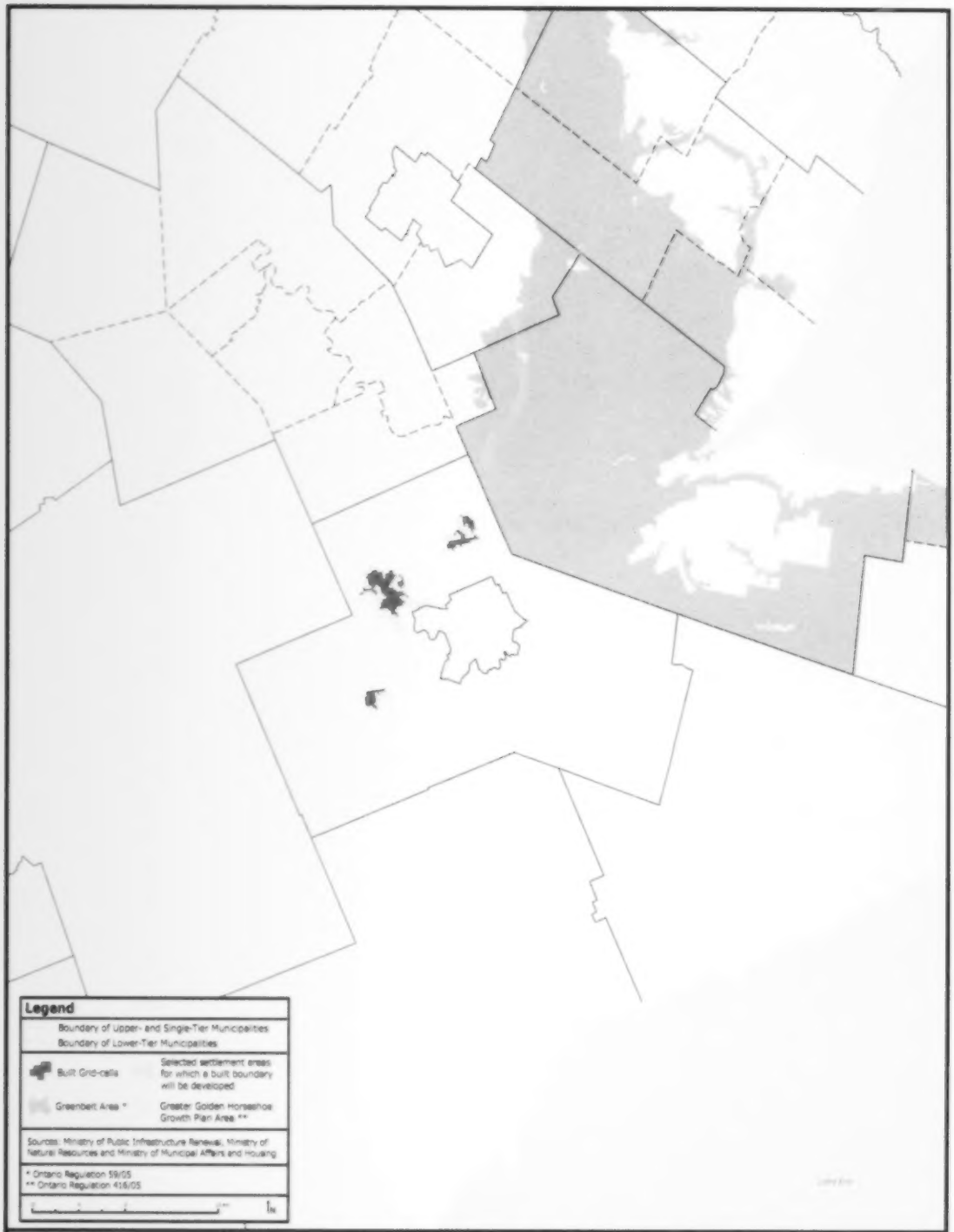
The following maps of upper- and single-tier municipalities in the GGH are in alphabetical order. These maps are all at the same scale.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05
N

Built Grid-cell Mapping for the City of Barrie

Appendix 6

The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.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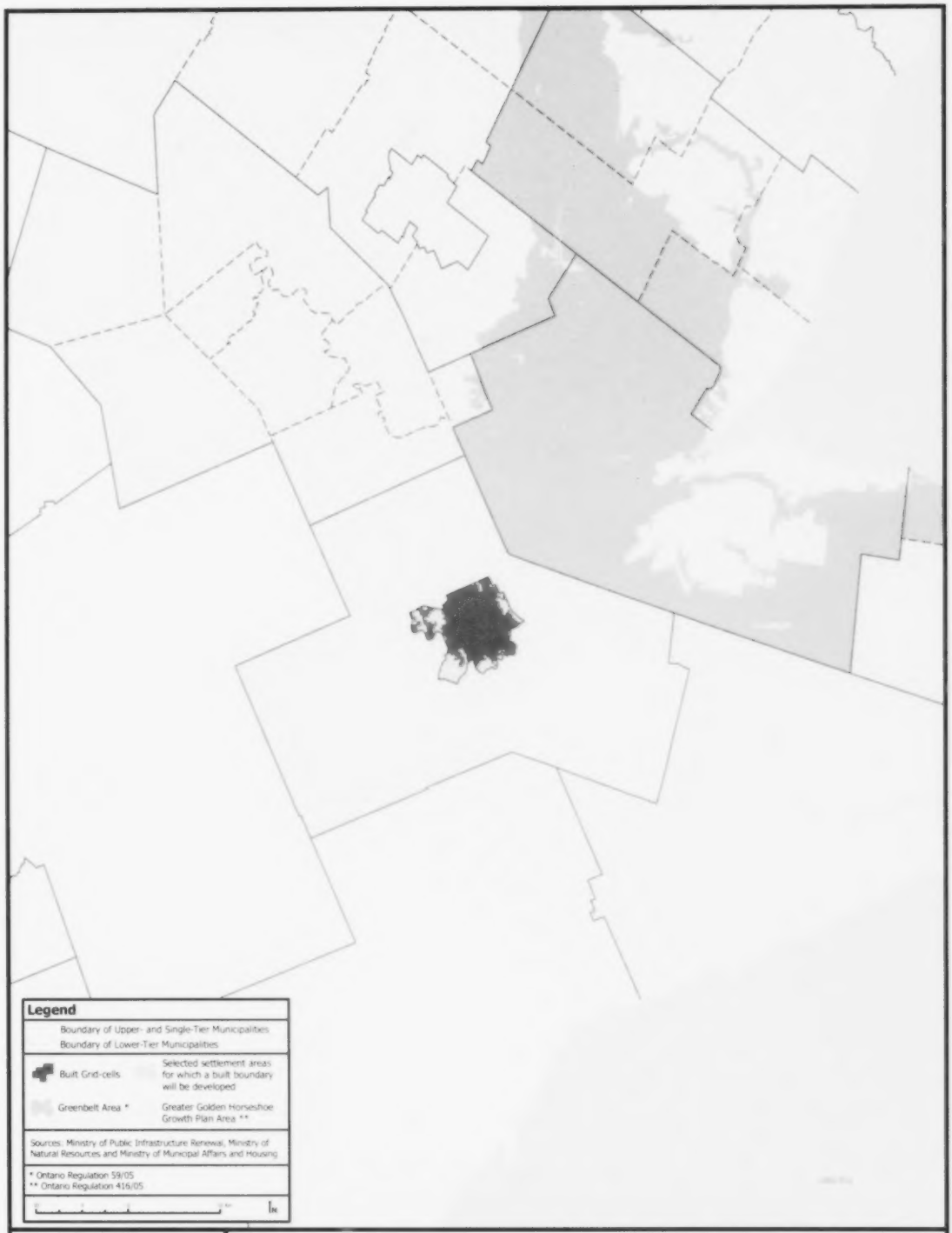
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the County of Brant
Appendix 6

The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.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Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05
N

Built Grid-cell Mapping for the City of Brantford

Appendix 6

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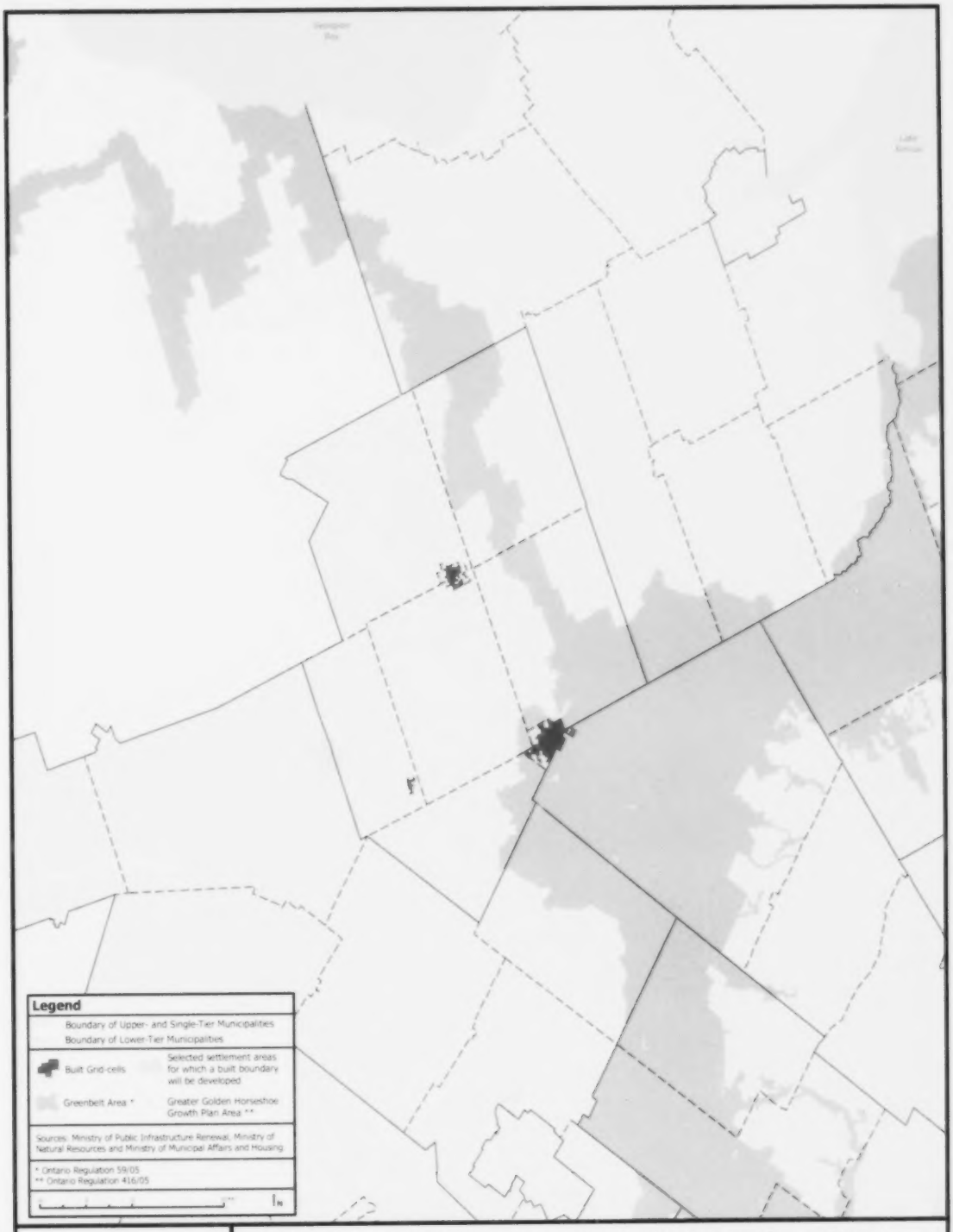
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Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the County of Dufferin

Appendix 6

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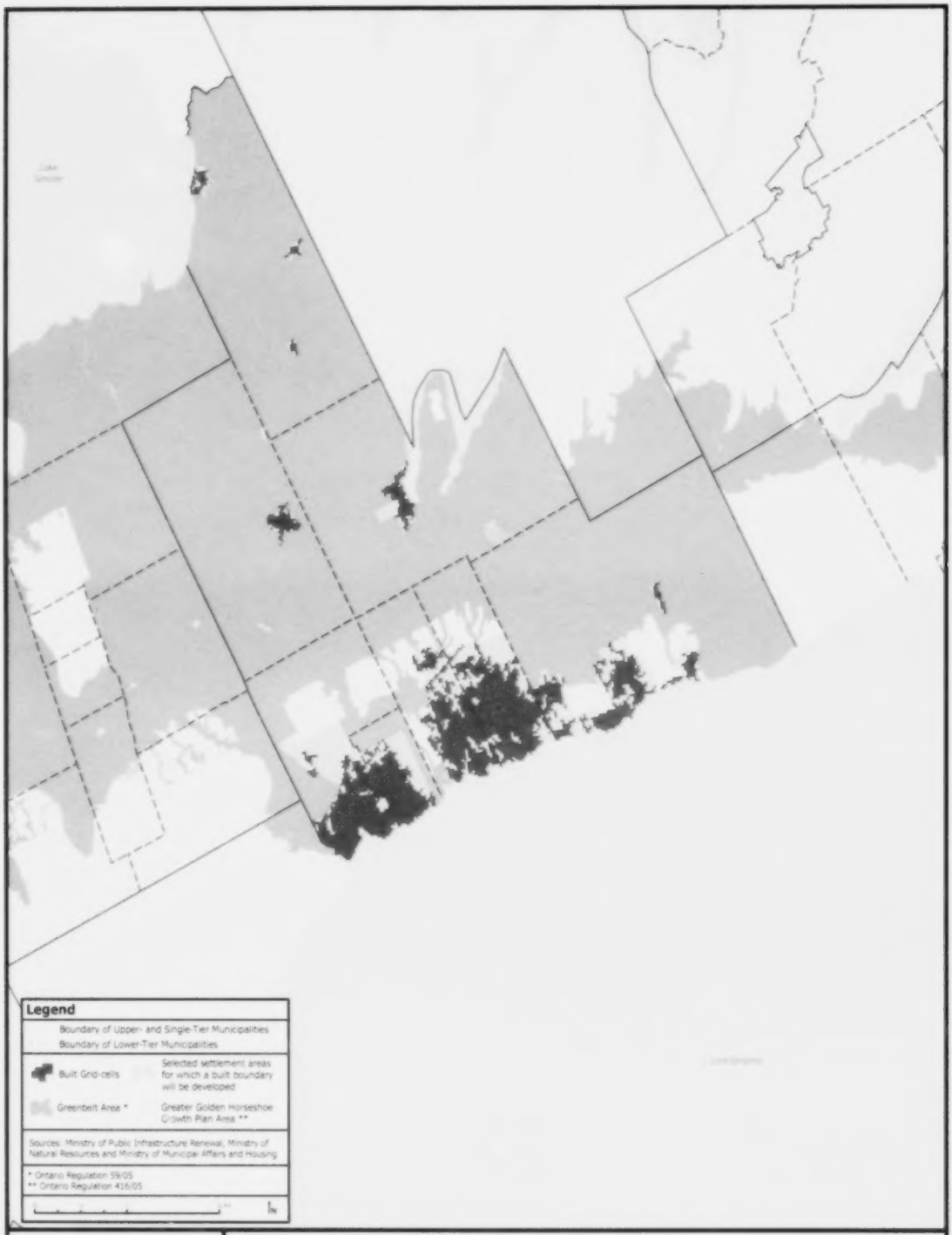
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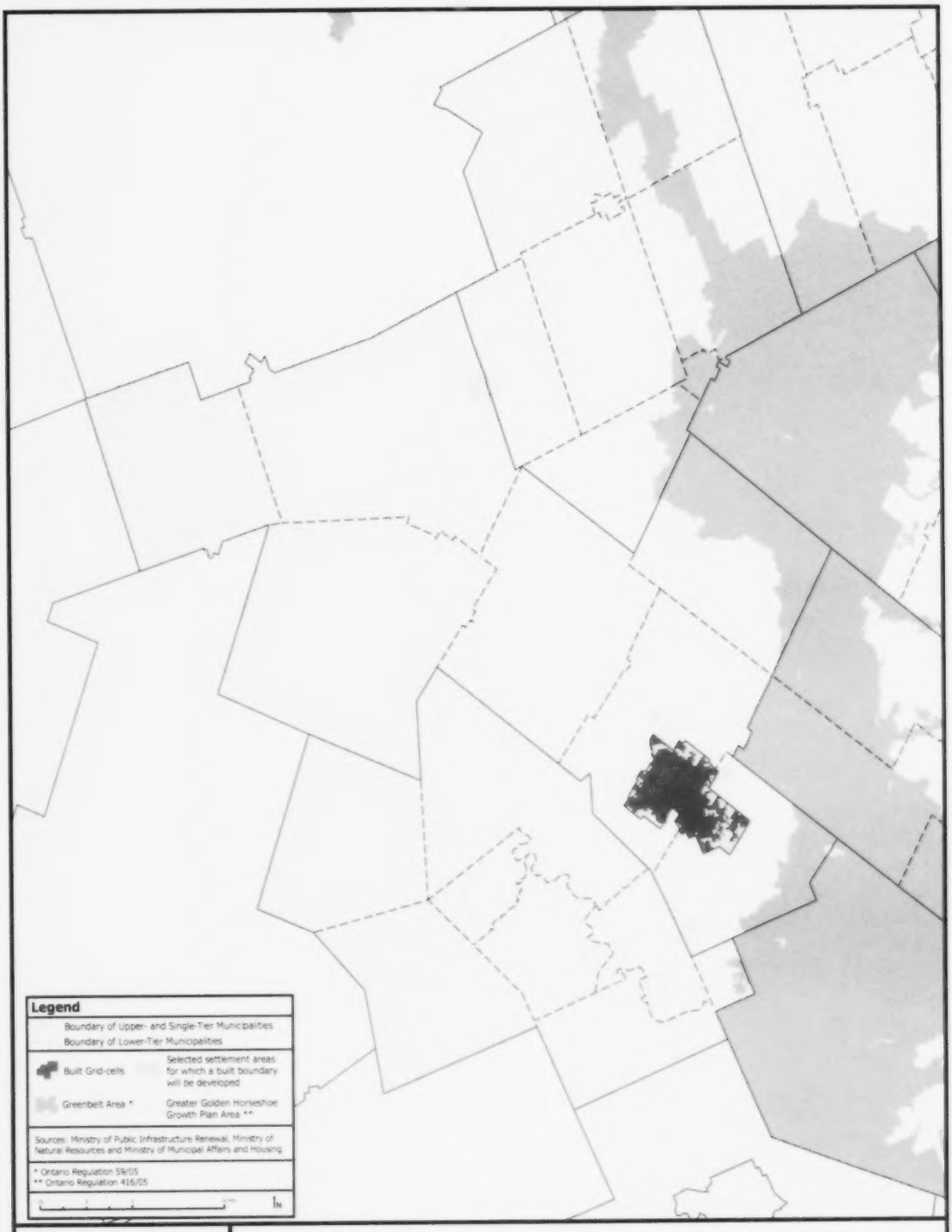
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the Region of Durham
Appendix 6

The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.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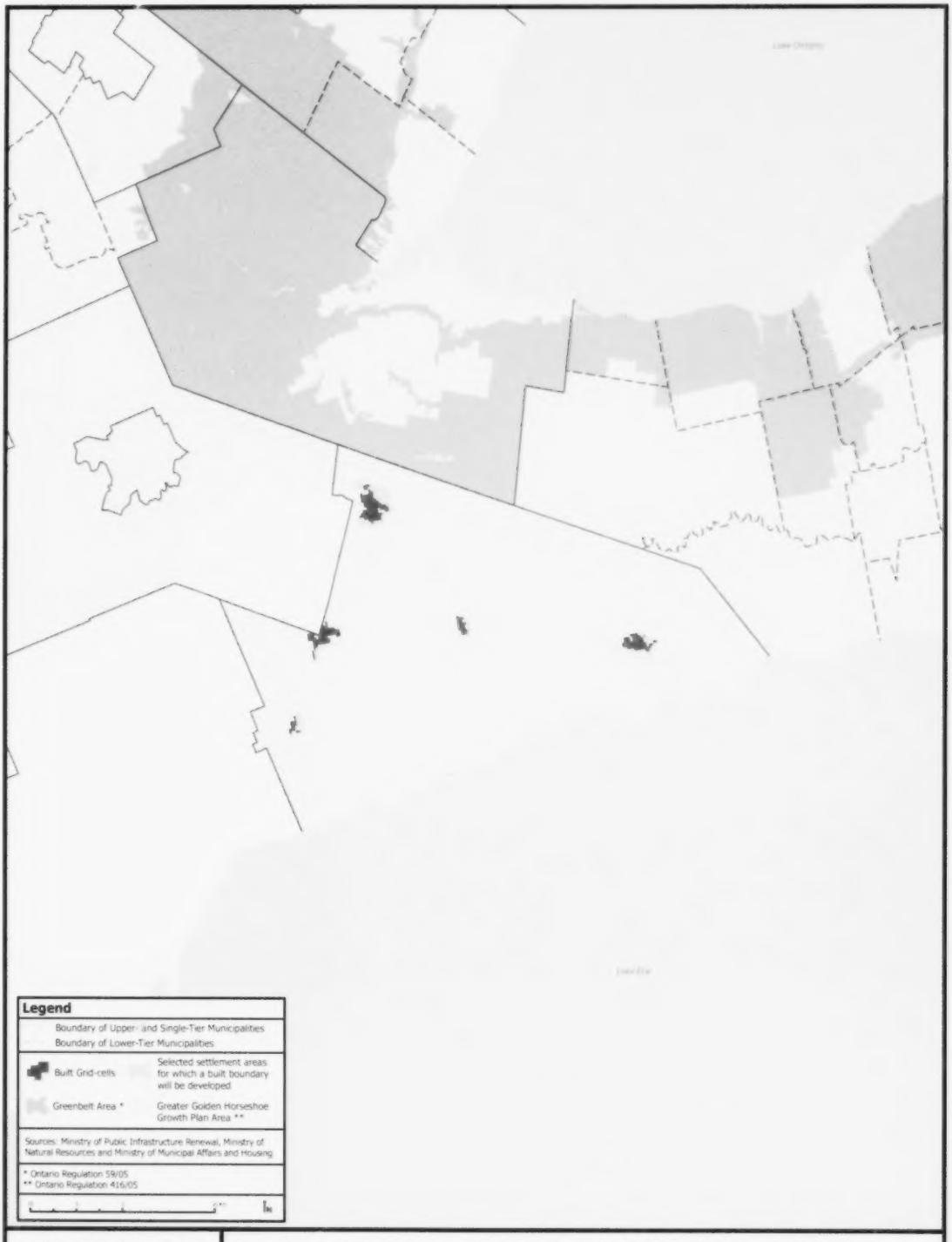
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05
1N

Built Grid-cell Mapping for the City of Guelph
Appendix 6

The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.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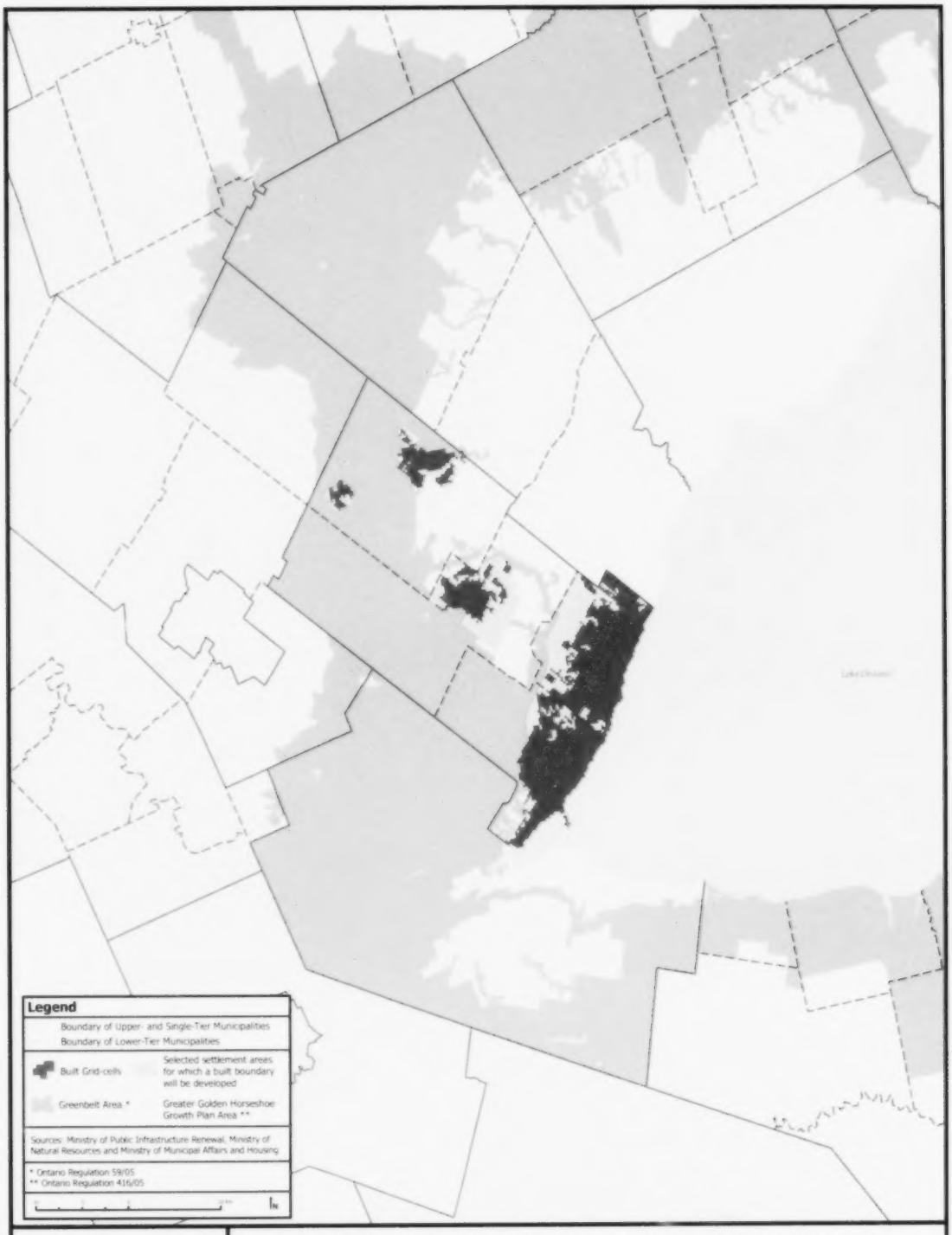
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the County of Haldimand

Appendix 6

The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.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Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the Region of Halton

Appendix 6

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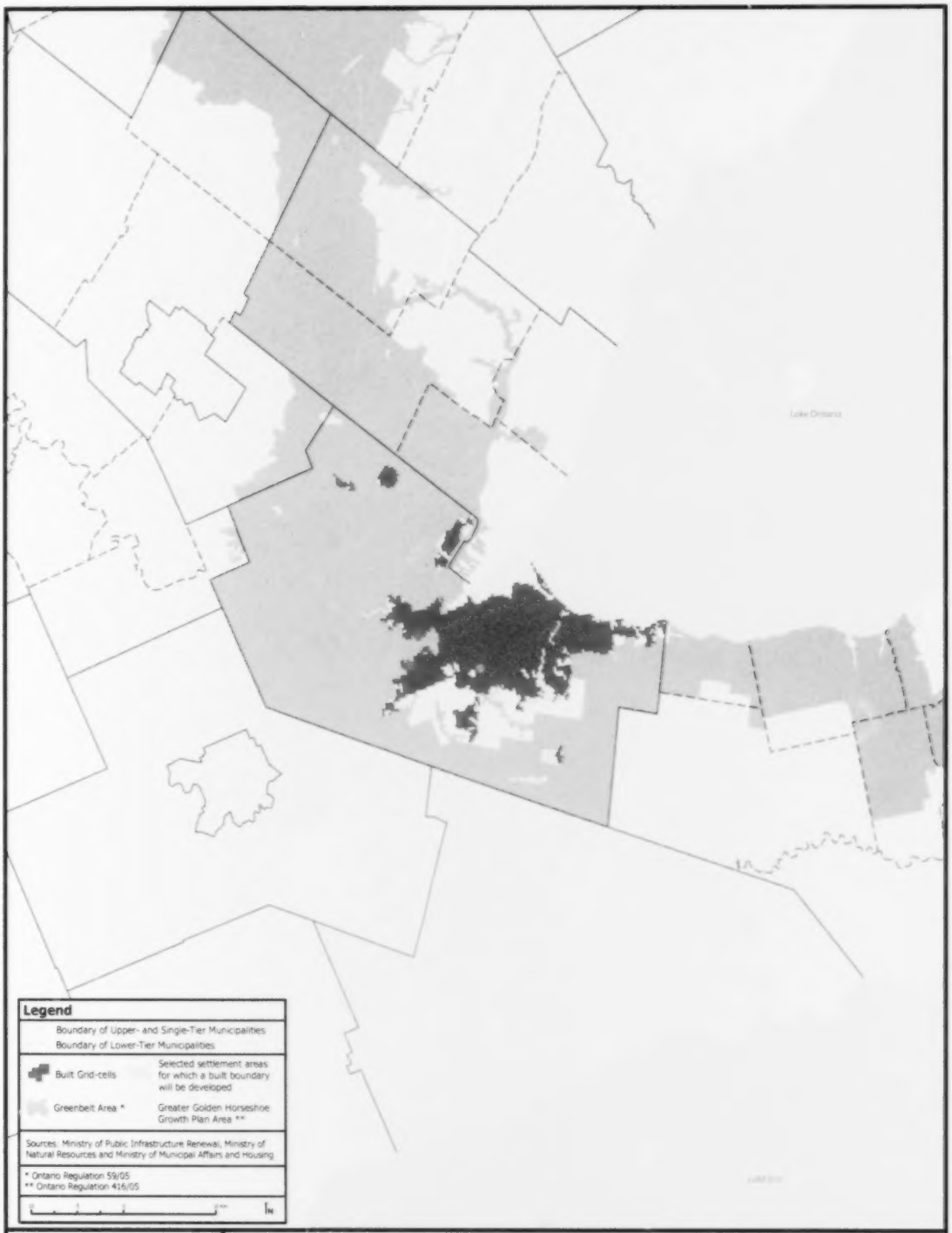
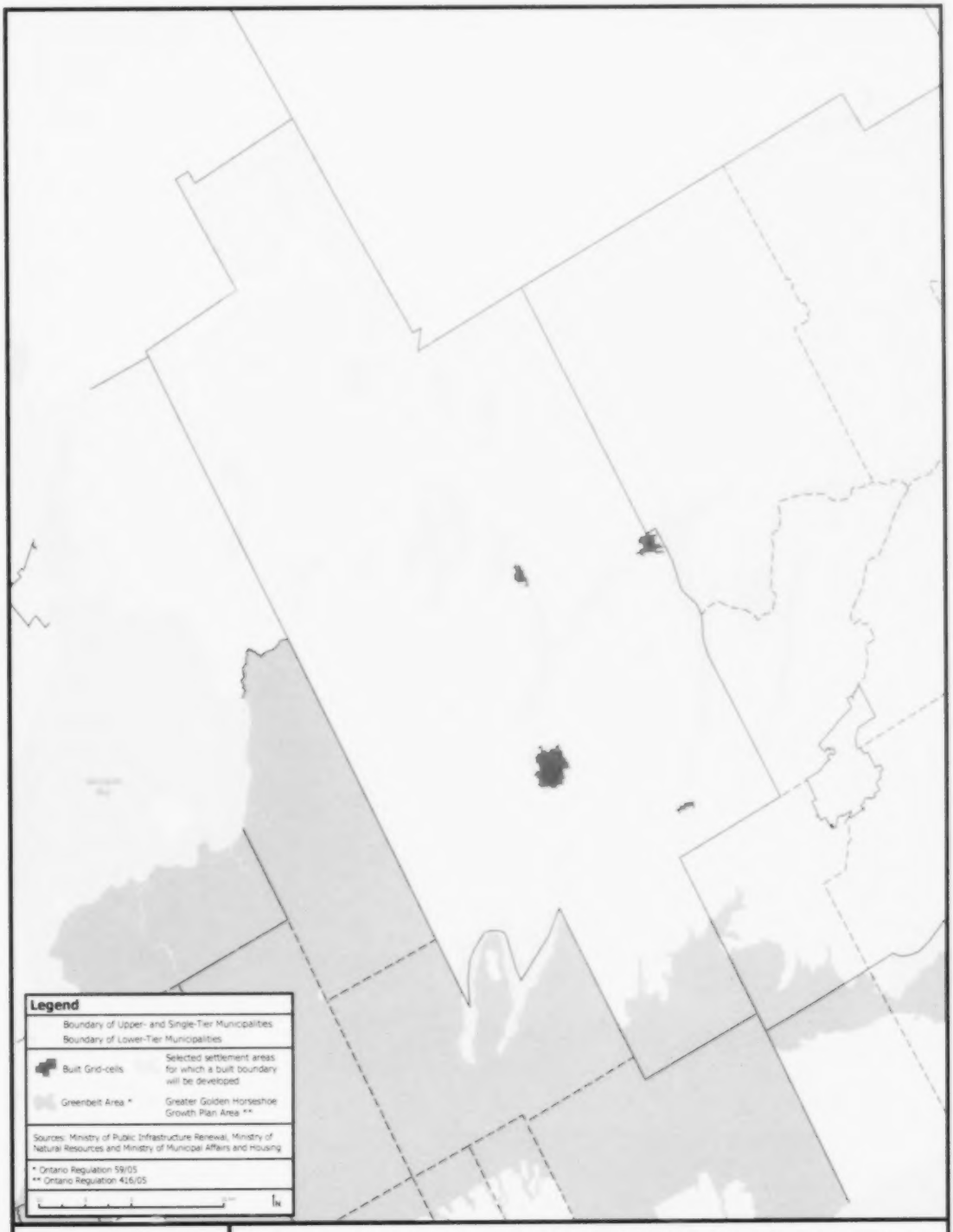

Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05
N

Built Grid-cell Mapping for the City of Hamilton
Appendix 6

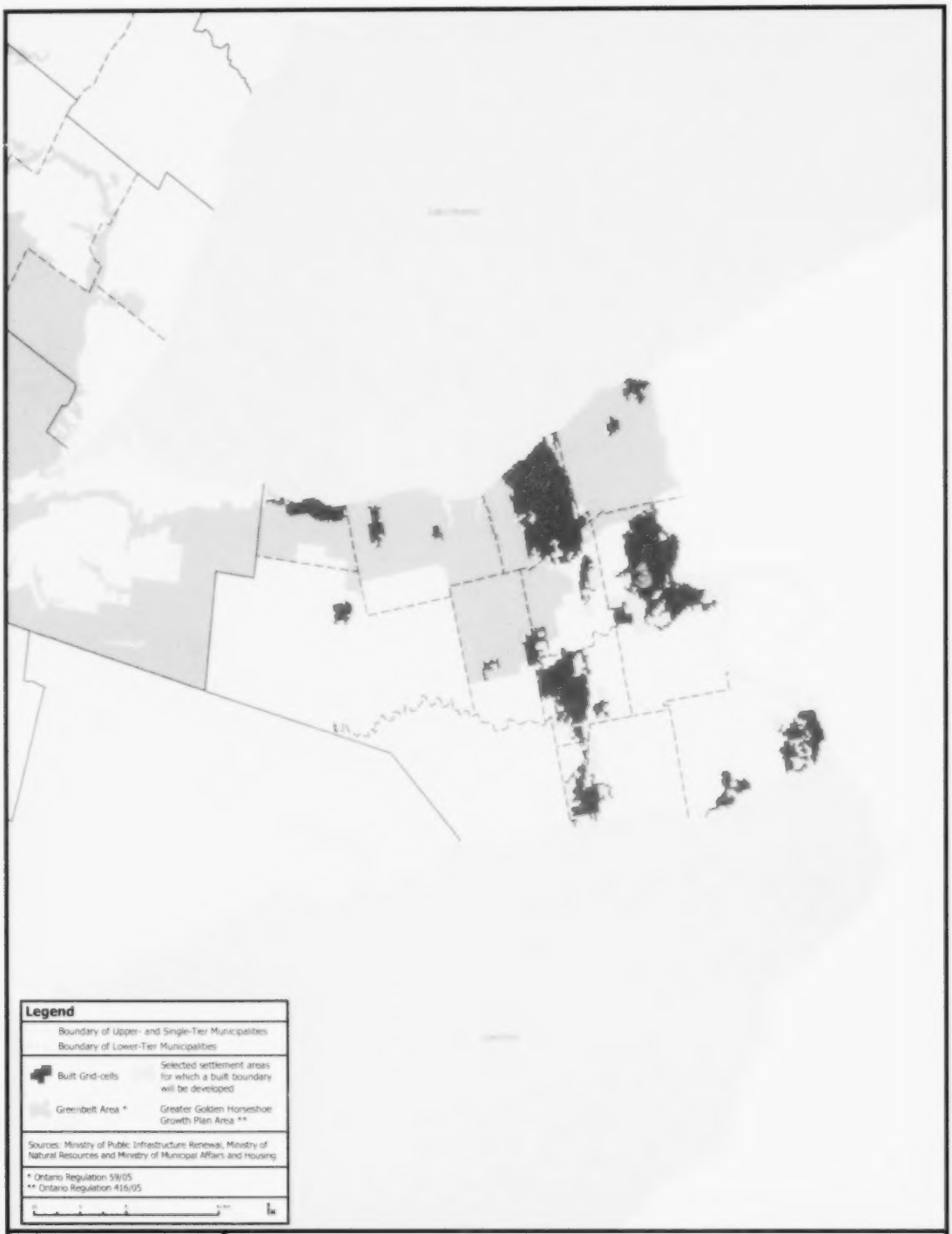
The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05
N

Built Grid-cell Mapping for the City of Kawartha Lakes

Appendix 6

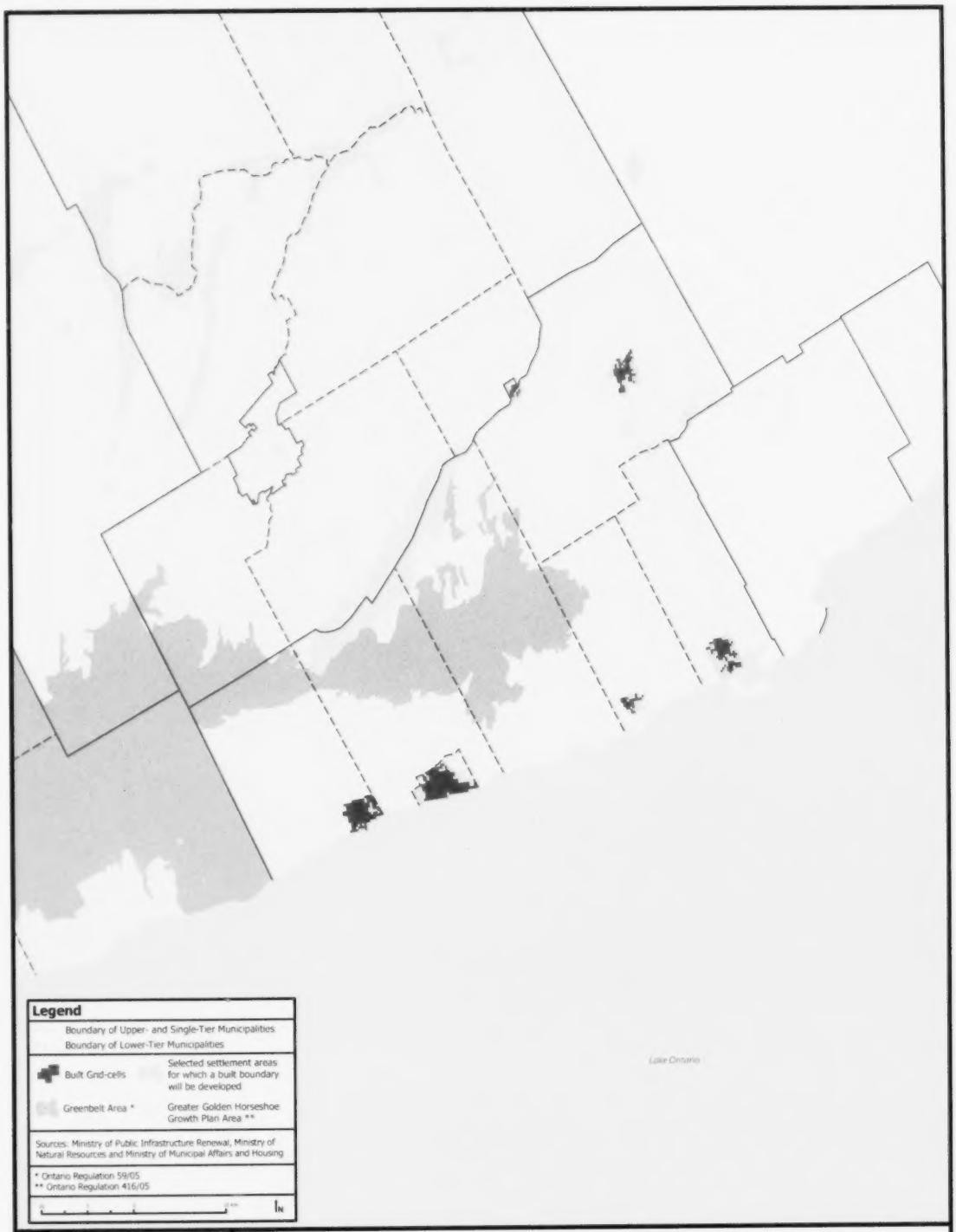
The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the Region of Niagara

Appendix 6

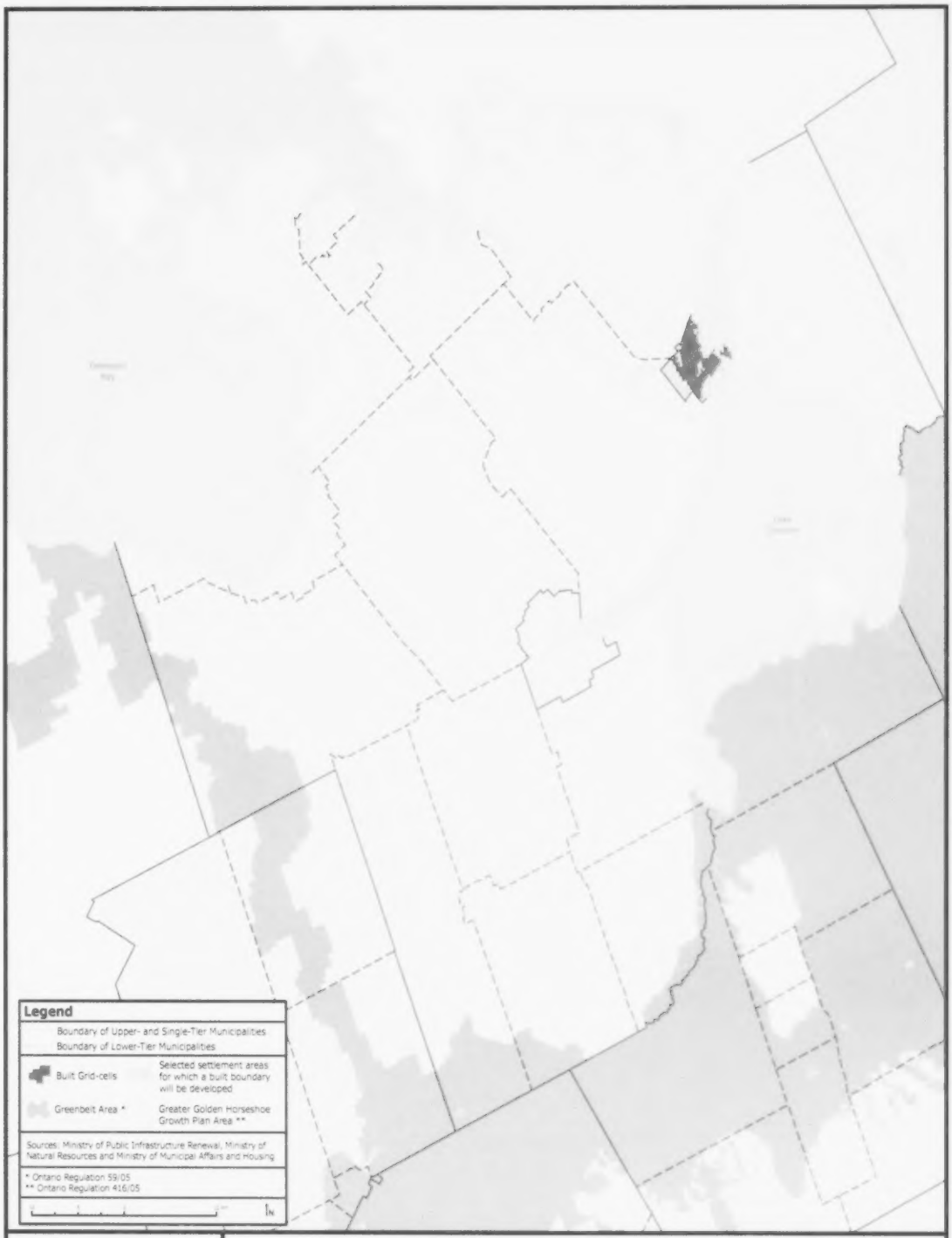
The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05
Lake Ontario

Built Grid-cell Mapping for the County of Northumberland

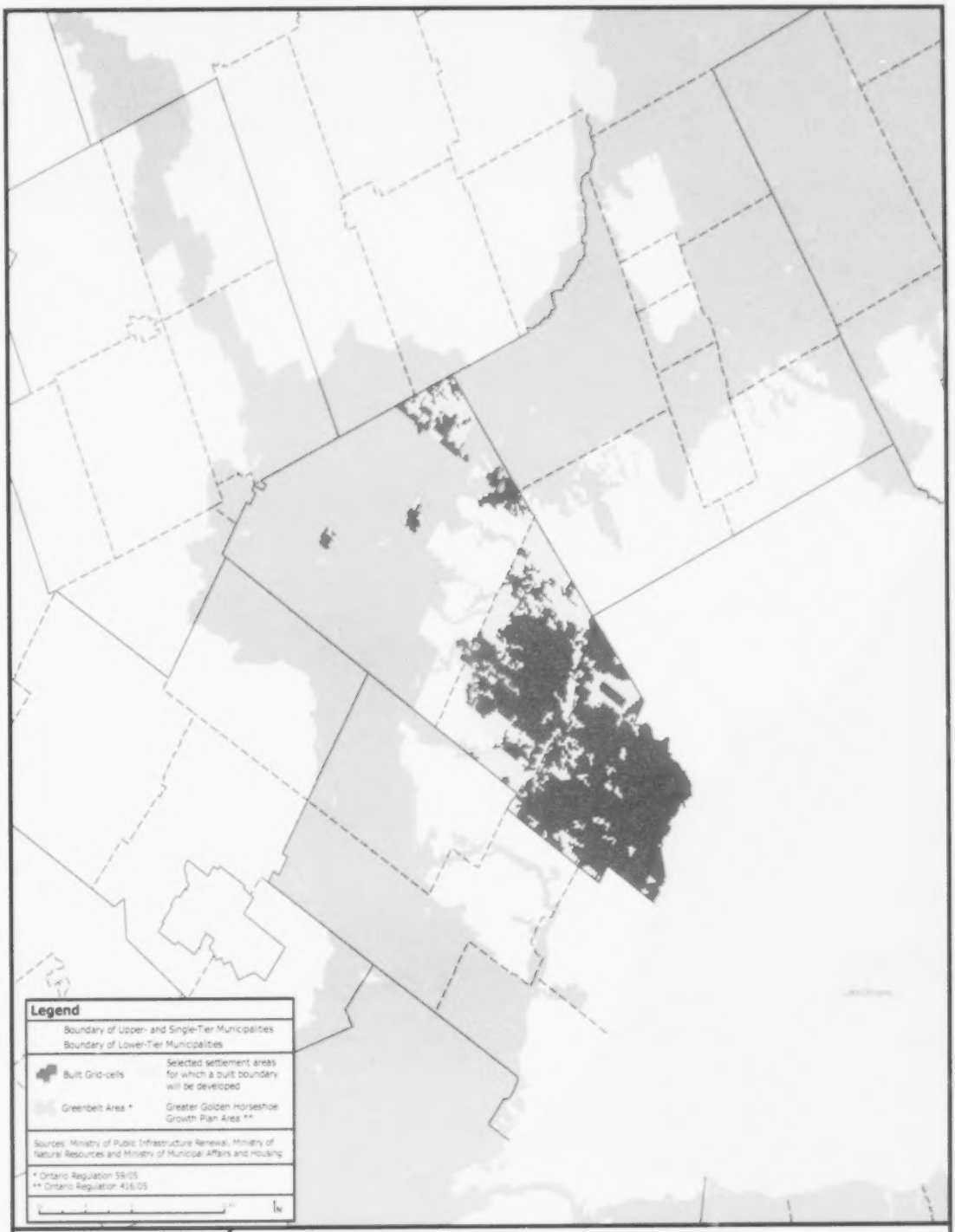
Appendix 6

The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the City of Orillia
Appendix 6

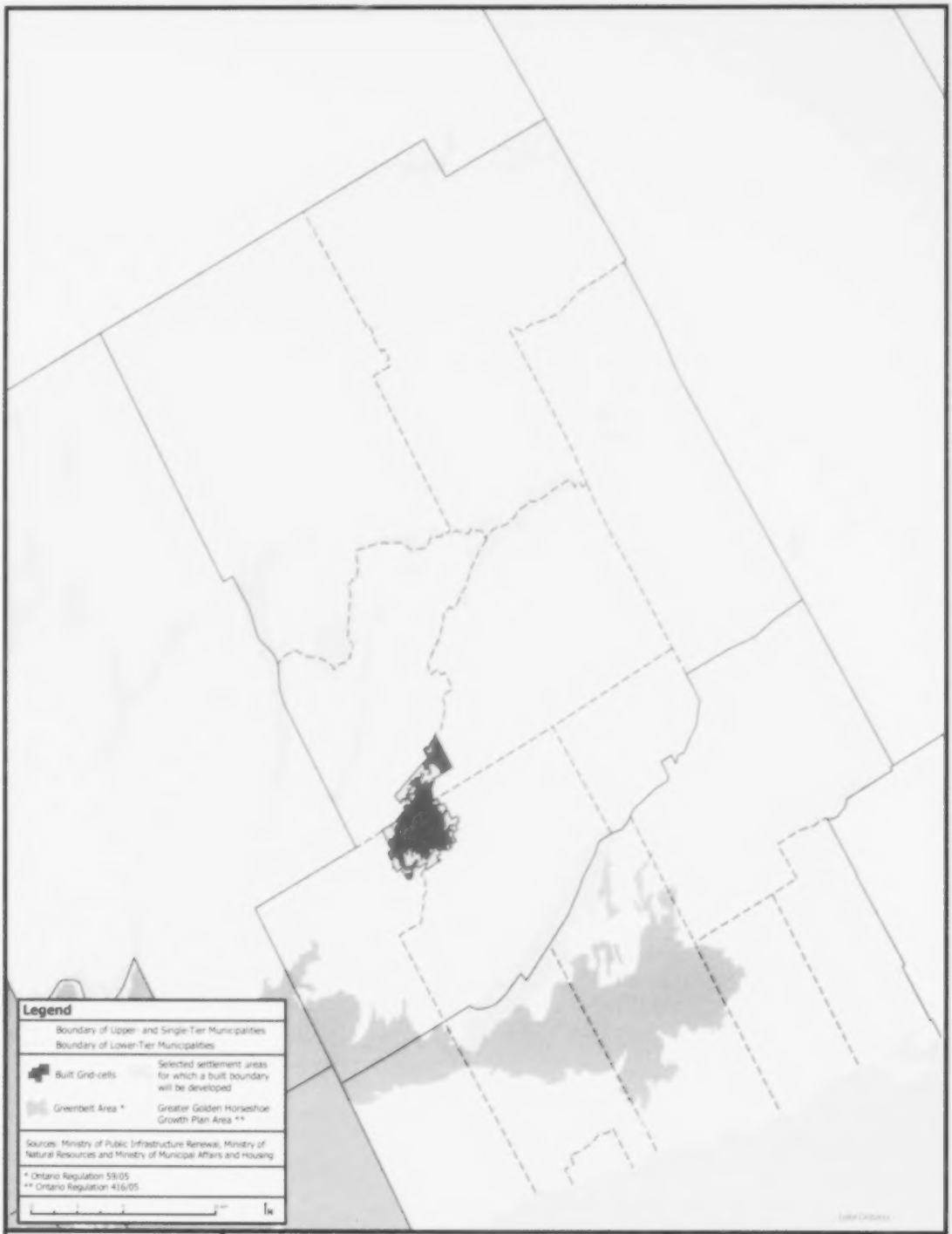
The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the Region of Peel

Appendix 6

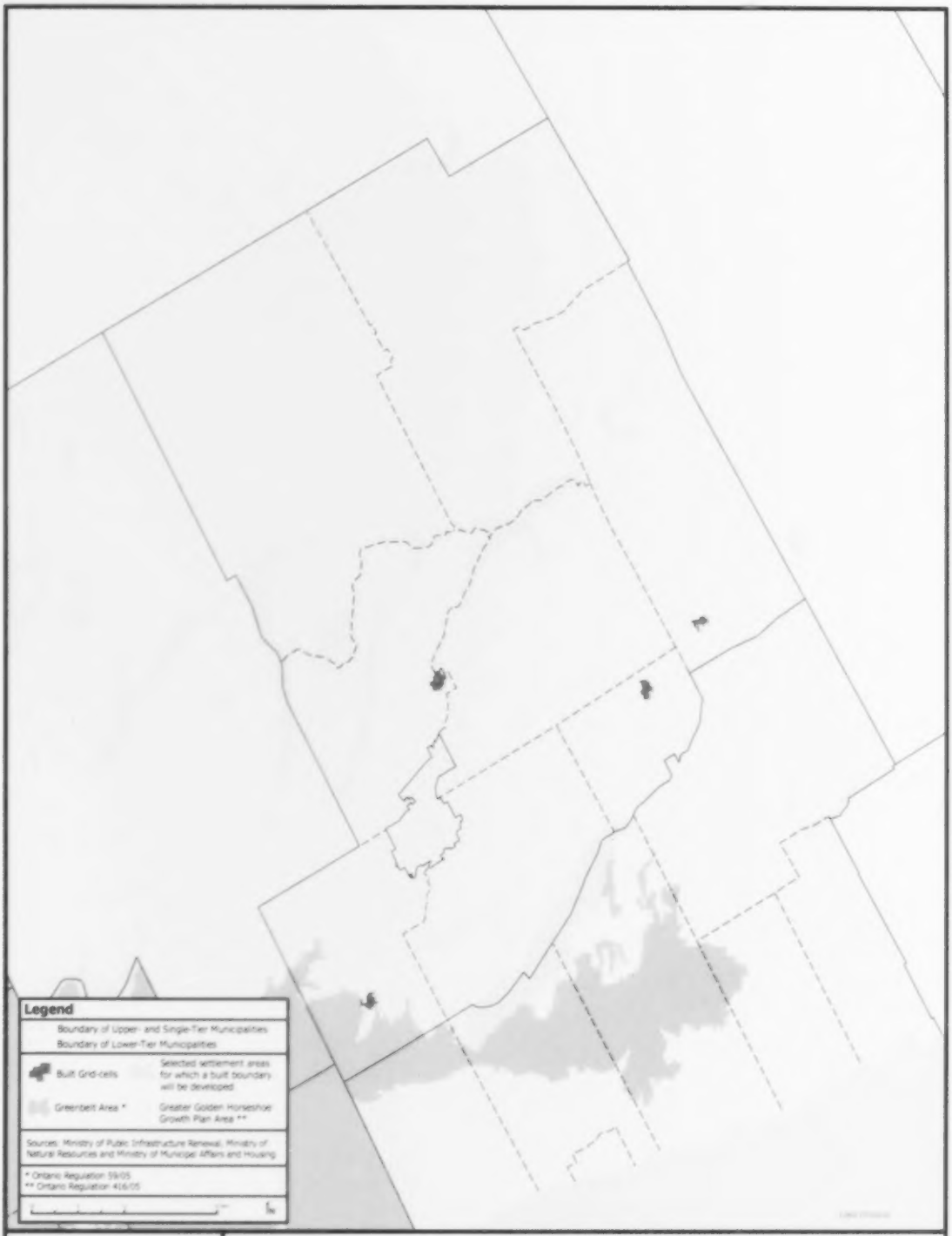
The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the City of Peterborough

Appendix 6

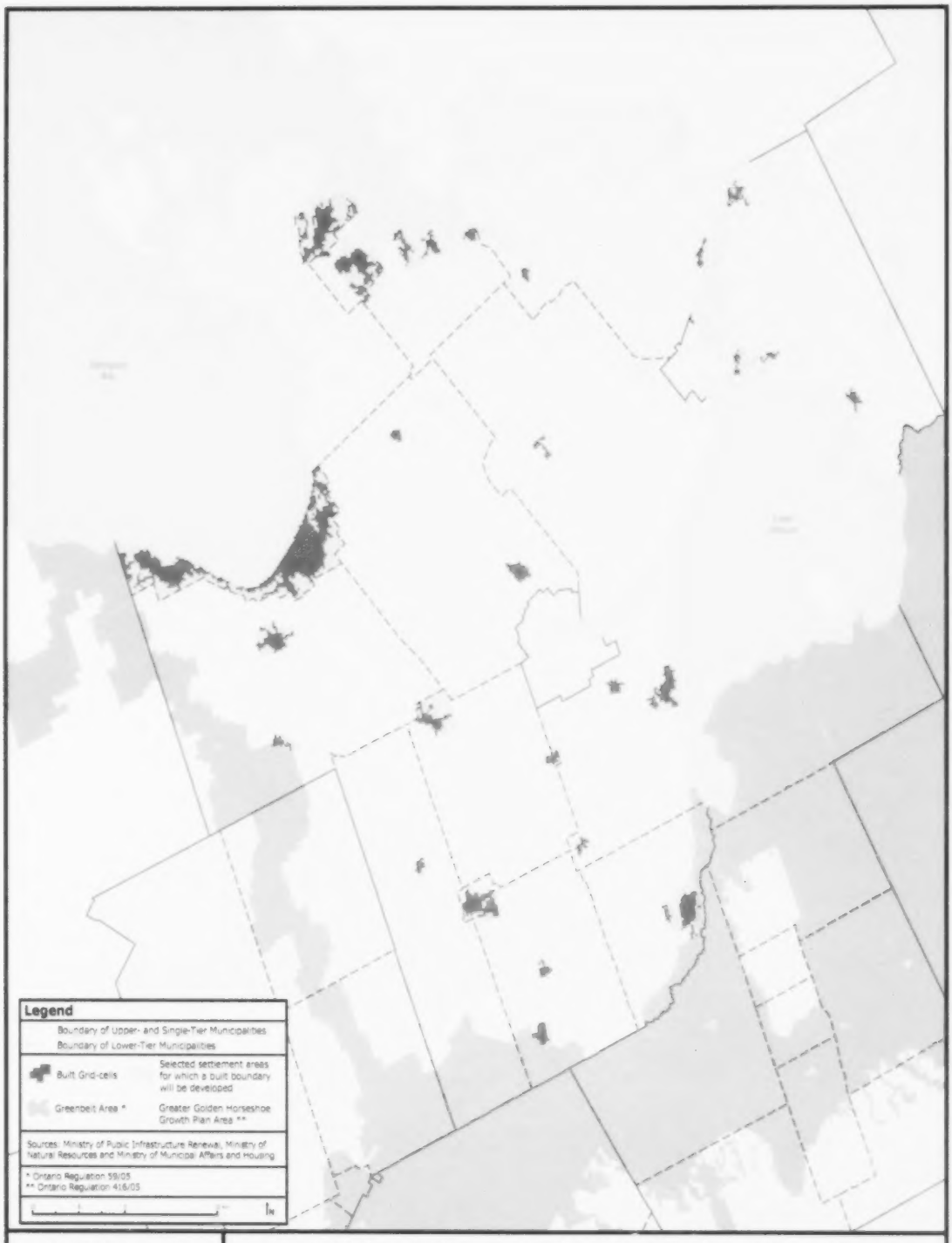
The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the County of Peterborough

Appendix 6

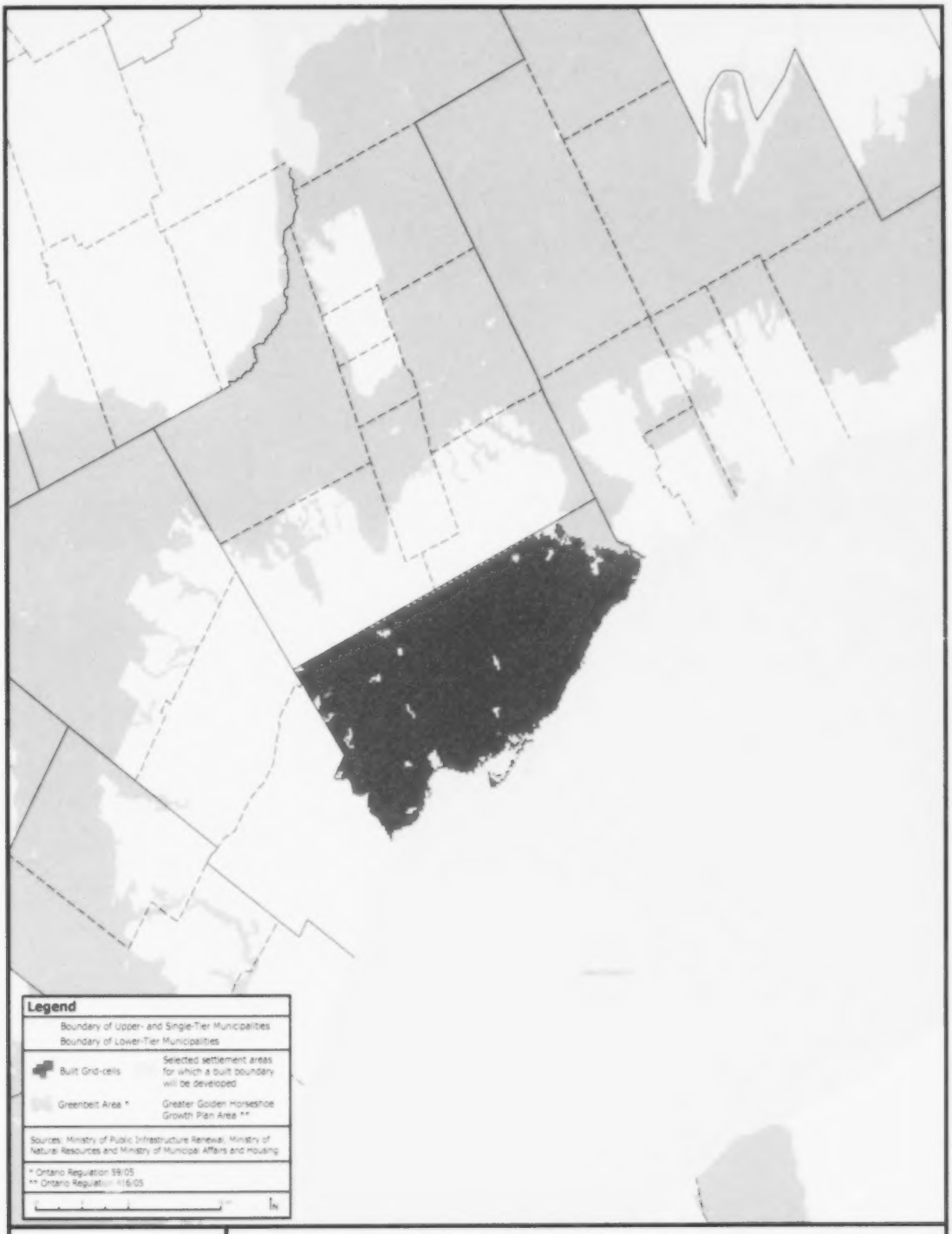
The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the County of Simcoe

Appendix 6

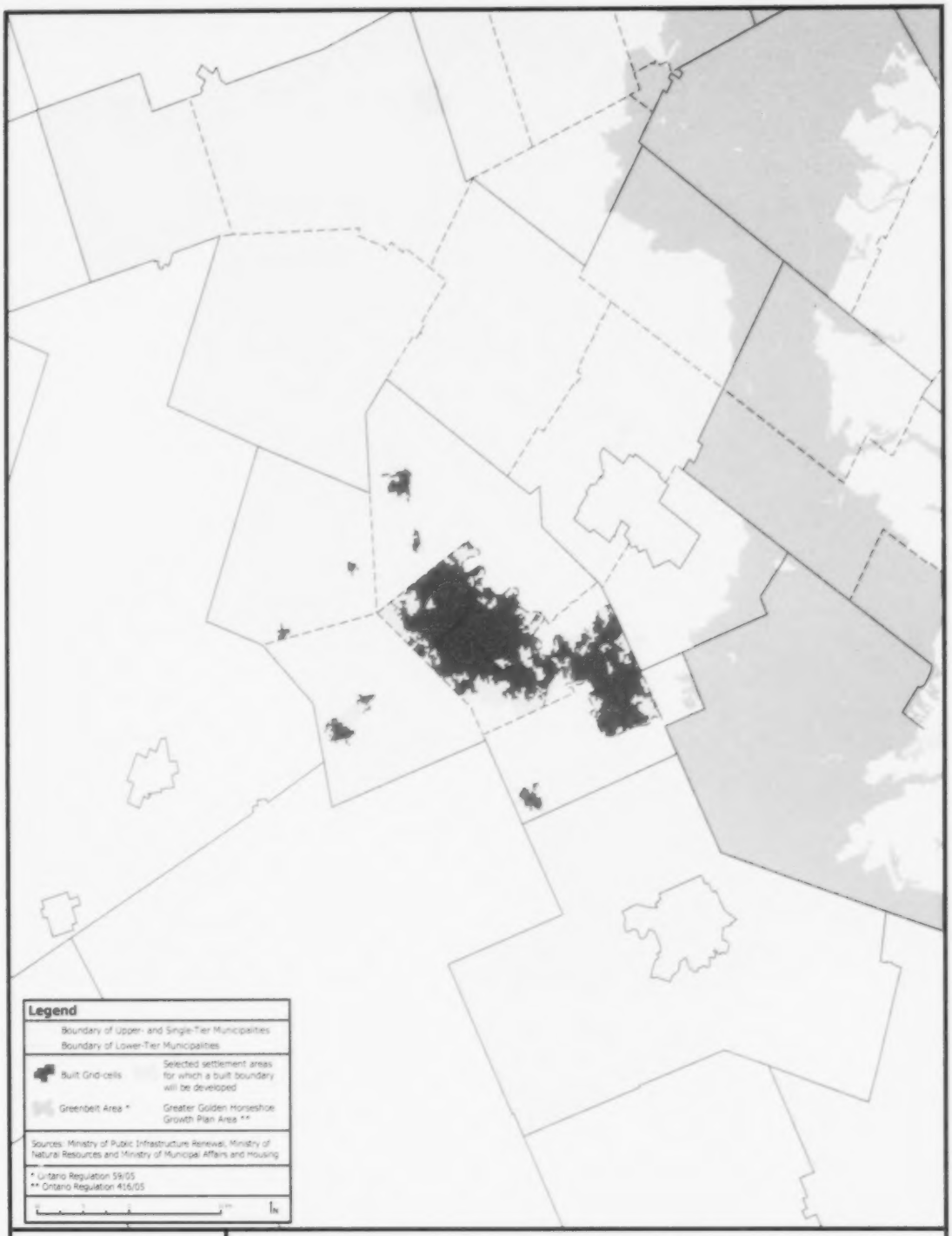
The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the City of Toronto

Appendix 6

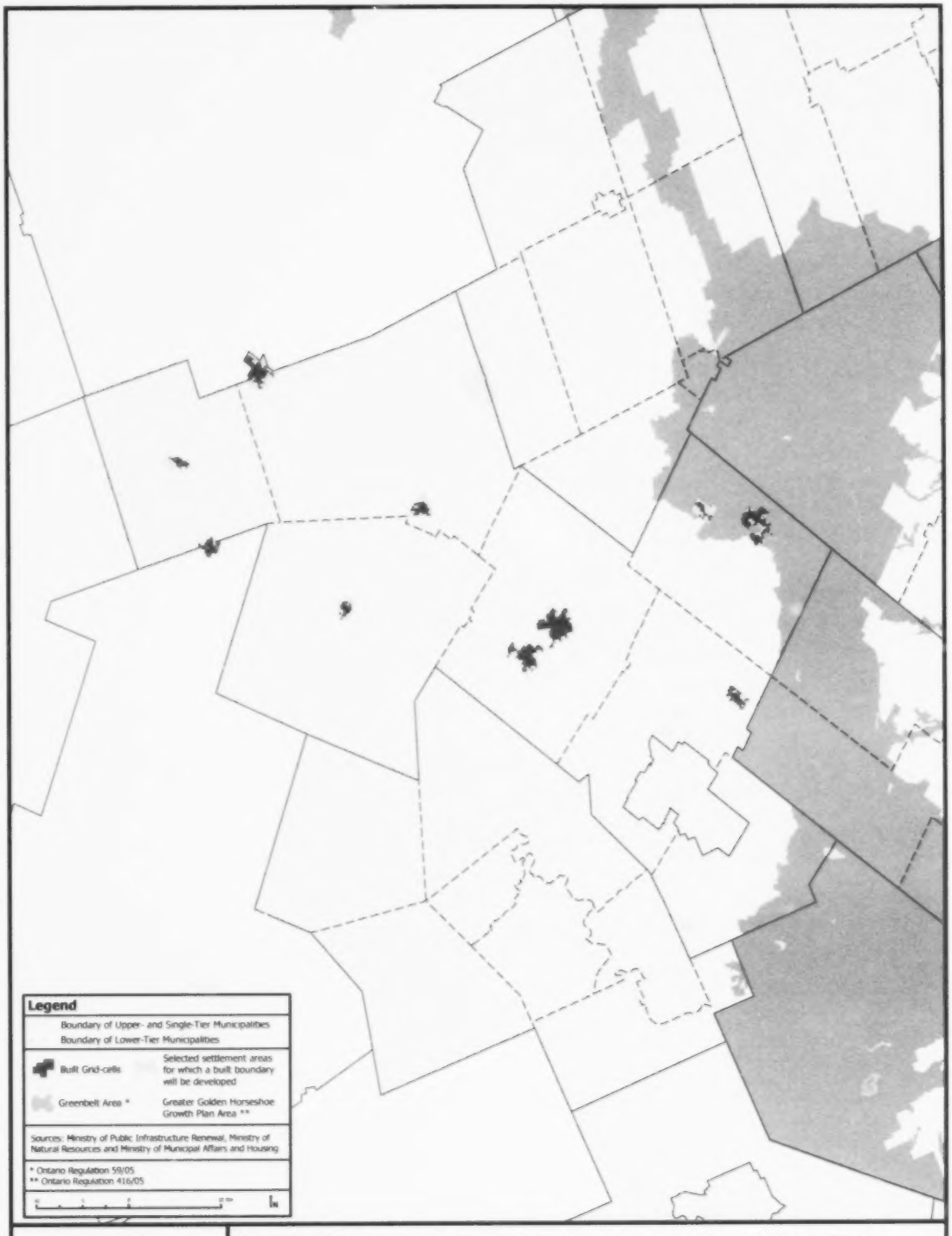
The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the Region of Waterloo

Appendix 6

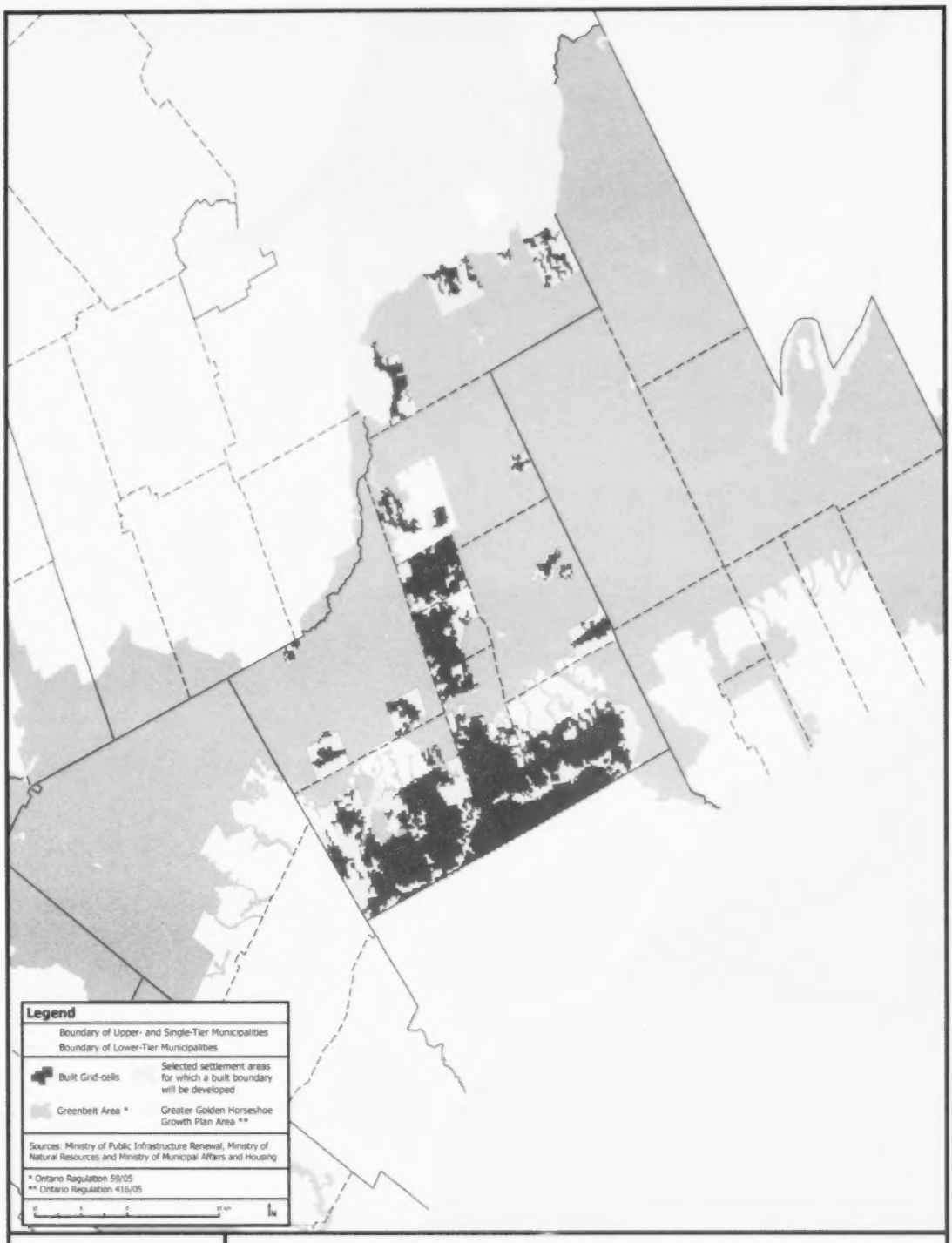
The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05

Built Grid-cell Mapping for the County of Wellington

Appendix 6

The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.


Legend
Boundary of Upper- and Single-Tier Municipalities
Boundary of Lower-Tier Municipalities
Built Grid-cells
Selected settlement areas for which a built boundary will be developed
Greenbelt Area *
Greater Golden Horseshoe Growth Plan Area **
Sources: Ministry of Public Infrastructure Renewal, Ministry of Natural Resources and Ministry of Municipal Affairs and Housing
* Ontario Regulation 59/05
** Ontario Regulation 416/05
N

Built Grid-cell Mapping for the Region of York

Appendix 6

The map illustrated above is based on the completion of Steps 1, 2, and 3 of the *Technical Paper on a Proposed Methodology for Developing a Built Boundary for the Greater Golden Horseshoe* released by the Ministry of Public Infrastructure Renewal in Fall 2006. The generalized built grid-cell mapping illustrated above represents built-up areas in selected settlement areas for which a built boundary will be developed. This is not a map of the built boundary as referred to in the *Growth Plan for the Greater Golden Horseshoe, 2006*. The information displayed above may not be to scale and may not accurately reflect approved land-use and planning boundaries, and may be out of date. For more information on precise land-use boundaries, the appropriate municipality should be consulted. The Province of Ontario assumes no responsibility or liability for any consequences of any use made of this map.

Appendix 7: Sources and currency dates of data

Attribute used/ Data	Source	Date
Primary Datasets		
Land uses and residential unit counts	Municipal Property Assessment Corporation	Current to end of 2005 (Tax Roll 2006 file)
Parcel geography	Ontario Parcel Alliance (Land Information Ontario)	January 2006
Settlement Areas	Ministry of Municipal Affairs and Housing	Winter 2005
Secondary Datasets		
Upper-, Lower- and Single-Tier boundaries	Ministry of Municipal Affairs and Housing	January 2006
First Nation's Lands	Land Information Ontario, Ministry of Natural Resources	January 2006
Datasets used to aid refinement in Step 4		
Ontario Road Network	Land Information Ontario, Ministry of Natural Resources	April 2006
Statistics Canada Hydrological Layer	Statistics Canada	2006
Othophotos (MrSid format) (full colour except for the Grand River Region)	Ministry of Natural Resources	2002 for entire GGH 2005 for the Greater Toronto Area and Hamilton

Please note that the refinement methodology described in this paper allows corrections for errors, omissions, and out-of-date elements in these datasets.

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